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IMPLEMENTATION OF ONE-TO-ONE COMPUTING: A QUALITATIVE CASE STUDY OF SUCCESS FACTORS FOR STUDENT TECHNOLOGY INITIATIVES

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IMPLEMENTATION OF ONE-TO-ONE COMPUTING: A QUALITATIVE CASE STUDY OF SUCCESS FACTORS FOR STUDENT TECHNOLOGY INITIATIVES

by

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DEDICATION

I dedicate this meaningful endeavor to my loving wife. Her steadfast support, sacrifice, and enduring devotion to our family made this possible. Her belief in my abilities, persistent encouragement, and personal support always kept the vision forward. Without her, I would never have completed any of my lifelong goals. I love you with all my heart and soul. You are my rock.

ACKNOWLEDGEMENTS

My academic pursuits have all grown from a strong educational foundation bestowed upon me by my parents. At a very early age, they sacrificed all they had to ensure my educational success. My mother gave 4 years of her career to stay home with and nurture me, while my father drove snow cone trucks in the summer to make ends meet. My parents were both public school science teachers of Grades 6 and 7. The research materialized through this study is grounded on their early teaching of the scientific process. Viewing the world with an objective lens was the bedrock of the "Underwood" way of life.

Their strong values help anchor me when life's trials challenged my success as both a professional and a man. I would not be where I am today without them. I really wish Dad was here to see the end result.

ABSTRACT

Implementation of One-to-One Computing: A Qualitative Case Study of Success Factors for Student Technology Initiatives

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The purpose of this case study was to discover what policies, actions, and experiences contribute to the successful implementation of a one-to-one student technology initiative in a K-12 public school district. A grounded theory approach and case study design offered an effective exploration of the specific events within the bounded system or case of technology integration. The participants represented three professional employee categories of central administration (n = 2), campus administration (n = 4), and teaching staff (n = 6). The large urban school district's majority of students were identified as economically disadvantaged. Twelve participants shared their experiences and perceptions of the implementation of the district's one-to-one mobile technology strategy in two high schools. In each high school, all students and faculty were issued a district-owned laptop device. The data revealed five emergent themes that explained aspects of the whole-school reform within the district that follow: (a) teacher and leadership "buy-in" or support; (b) communication of the initiative; (c) need for reliable and consistent hardware and software; (d) outcomes, goals, and evaluations; (e) professional development. The efforts of this investigation identified several implications for practitioners seeking to enact best practice one-

to-one strategies during future technology initiatives and whole-school reform efforts. Quantitative and qualitative investigation methods could be used in follow-up research of the central themes identified in this case study's findings.

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CHAPTER ONE: INTRODUCTION

Access to mobile personal technologies by students has been accelerating since the beginning of the 21st century, and educational leaders have been adapting the norms and standards of traditional pedagogy at both the elementary and the secondary levels to fit into a technology driven educational climate (Barr & Sykora, 2015). An enormous investment has been made on digital tools and resources (Moersch, 2014). Over $5 billion are spent annually by schools to incorporate technology, and technology has been integrated in public schools in a variety of ways (Moersch, 2014).

First the computer labs of the 1980s and 1990s have given way to school districts issuing individual, personal devices to students as a means of enhancing the educational experience through one-to-one ratios by providing an enormous resource to remediate, extend, and personalize student learning. In 2010, a survey conducted by the National School Boards Association indicated that 37% of the participant school districts have some type of one-to-one computer initiative in place, and the number of school districts employing one-to-one computer programs continues to grow (Nagel, 2010). Although one-to-one student technology programs are gaining in popularity, they still are relatively new (Sauers & McLeod, 2012).

The first step in the implementation of ubiquitous technology is enabled through a comprehensive and responsive vision. The superintendent must interconnect include human capital, infrastructure, and finances as part of enacting and sustaining any digital evolution within the school district (Delgado, Wardlow, McKnight, & O'Malley, 2015). Infrastructure includes bandwidth for ensuring all devices used by teachers,

administrators, and students alike can be used simultaneously throughout the school day. As more users attempt to use a Wifi system, for example, the bandwidth suffers from loss and speed of information transfer decreases, particularly if the infrastructure for the system is not powerful enough to handle the number of devices using it at any given moment in the school day (Moersch, 2014). Student devices and wireless infrastructure are obviously central to the integration processes; however, the human capital development of campus leaders and technology integration specialists, or coaches, is necessary for a sustainable vision of technology integration and upgrade. Simply providing access technology to the environment without support would be extremely shortsighted (Carlson & Gadio, 2002).

Leaders in today's public schools must also embrace a new way of leading that focuses on teacher training, pedagogy, and culture development to withstand the rapidly changing landscape. Providing the technical support and resources for one-to-one computing integration is only a small part of successful technological integration. A cultural shift must enable an organization to grow from within and respond to the many challenges that often accompany such a whole school reform effort. For this effort to be successful, a focus must be placed on building the capacity within the organization (Moersch, 2014).

Without strong leadership, schools' digital transformations do not produce the stability and resources needed to effectively operate the learning environment and can be disruptive even if the goal of implementation involves providing a culture consistent with evolution rather than revolution (Puckett, 2014). Both human capital and financial

resources are paramount to enacting and sustaining the one-to-one digital evolution on school campuses. Fundamental resources, such as bandwidth, student devices, and wireless infrastructure are obviously central to the integration processes; however, campus leaders and integration specialists or coaches need training and development to assist in changing the environment's technology culture beyond simply providing access to the technology.

In addition to resources and vision, digital citizenship responsibilities must be imbedded in the curriculum and policy (Mossberger, Tolbert, & McNeal, 2007). Enabling a digital environment also calls for the education of the learner for success in the digital environment. Professional development and parent communication are also found throughout the literature as vital components found during successful implementation strategies (Mossberger et al., 2007; Moersch, 2014; Mackie, 2009). Moersch (2014) noted that very little research has been conducted to support the successful implementation of technology in schools given that several factors must be considered when implementing technologies on campuses. This study helped provide focus to and consolidate the logistical steps of effective technology integration in K-12 education, while underscoring the necessity of building and maintaining a strong culture throughout the implementation process.

Statement of the Problem

The immersion of technology resources in K-12 public schools has increased rapidly over course of the 21st century (Ackerman, 2017). The highly-publicized failure of the Los Angeles Unified School District's mobile technology implementation brought

an enormous amount of public scrutiny to the educational concept (Wan, 2015) and highlighted the importance of identifying best practice strategies to ensure the successful implementation of technology initiatives. While school leaders often seek informal guidance on decision making about technology integration from other districts which have already implemented technology initiatives, such guidance seeking often provides only fragmented advice and vague roadmaps that are focused on the logistics of a technology initiative rather than on the leadership considerations for attaining success (Cohen, Arnold, Flanagan, Nolin, & Turner, 2014). There are multiple anecdotal sources and suggestions through organizations, such as International Society for Technology in Education (ISTE) and the Future Ready, but very little research was used to discover the factors contributing to the successful implementation of student mobile technology initiatives. Given the likelihood that one-to-one technology would remain in use throughout the K-12 education sector, research to understand how to effectively implement the technology was recommended (Moersch, 2014).

Purpose of the Study

Research about mobile technology immersion in the K-12 public school setting is limited (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2010; Gulek & Demirtas, 2005; Lemke & Martin, 2003, 2004a, 2004b, 2004c). The purpose of this case study was to discover what policies, actions, and experiences contribute to the successful implementation of a one-to-one student technology initiative in a K-12 public school district in Texas. Several factors found in the literature were the complex interactions of vision, leadership, curriculum, pedagogy, professional development, technical support,

funding, and communication. The perceptions of teachers, campus administrators, and executive administrators at the central office level may allow the researcher to garner data related to everyone's experiences within their social contexts (Willis, 2007). A grounded theory approach and case study design may offer effective exploration of the specific events within the bounded system or case of technology integration (Merriam, 2009).

Research Questions

This study was focused on the following research questions:

1. What factors contributed to the successful implementation of the school districts' one-to-one mobile learning initiative?
2. What challenges do the participants identify as present during the implementation of the school district's one-to-one mobile learning initiative?
3. What recommendations about the sustainability of successful one-to-one mobile learning initiatives do the participants have?

Overview of the Methodology

This qualitative study used a grounded theory approach and a case study design to investigate the implementation of one-to-one computing in a K-12 public school district that experienced successful student achievement measures as evidenced in the state accountability system. A grounded theory approach allowed the researcher to use research and past practices to develop a theory of outcomes through interactions, relationships, and processes. Theory could be discovered by conducting both a review of the literature and a comparative analysis of participants' individual responses based on

their experiences with successfully implementing one-to-one mobile learning initiatives in the K-12 environment (Creswell, 2007).

Case study research as a qualitative approach enables researchers to investigate a relative, practical, and contemporary study of a bounded system over time and via targeted, in-depth data collection (Creswell, 2007). The data collection occurred with multiple sources of information and led to the production of a case description with case-based themes and to enable the generation of in-depth and rich responses from stakeholders who participated in the district-wide digital transformation. The contextual nature and factors affecting the case and the implementation process and factors were described.

The case, or bounded system, for this study was an urban public school district in Texas. The perceptions of stakeholders involved in the technology initiative's implementation were collected through interviews conducted with administrators, school district executives, principals, and teachers. Participants were drawn from the bounded system's population of stakeholders (Merriam, 2009). The inclusion criteria required that participants were involved in or experienced the integration of the technology integration. Additionally, data were collected through several methods, including document reviews, open-ended items on a questionnaire, and semi-structured interviews.

Theoretical Framework

The Future Ready Framework designed by Future Ready Schools (2015) as well as the essential conditions designed by the International Society for Technology and Education (2016) helped guide and frame the following tenets examined by the research.

This Future Ready Schools (2015) model exemplified an effort to engage public school district leaders across the nation interested in accelerating the transformation of schools through the effective use of digital learning strategies. This coalition was supported by the Alliance for Excellent Education and the United States Department of Education and defined seven fundamental *gears* as necessary for digital learning integration. The eight concepts of the Future Ready Framework by Future Ready Schools are paraphrased in the following enumerated bullet points:

1. *Curriculum, instruction, and assessment* includes the richness of technology in the teaching and learning process. Data are provided in a real-time environment that enhances and paces the learning objectives.
2. *Use of space and time* moves learners away from the traditional bell schedule occurring 5 days per week and 7 hours each school day. Learning is available to the students whenever time allows and concept mastery guides the learning process rather than time on task.
3. *Robust infrastructure* provides system checks for the reliability of devices, availability of network resources, and cyclical replacement and upgrade plans.
4. *Data and privacy* require secure and private networks and data systems for supporting a technology rich learning environment. Policies and procedures are also addressed in this gear.
5. *Community partnerships* provide opportunities for schools and industry to work together to enhance students' learning experiences, to produce more

educated workers, and to provide a more relevant curriculum that addresses the need to today's workforce.

6. *Personalized professional learning*, also referred to as digital professional learning communities (PLC), allows for teachers and administrators to work toward strong instructional processes by providing specific training and feedback via technology aided tools.
7. *Budget and resources* assure flexibility in funding, identification of additional resources, and examinations of ways to attain cost savings in a technology rich environment.

The second overarching component of the theoretical framework for this study involved the essential conditions provided by the ISTE (2016). ISTE (2016) designed basic required frameworks to enable one-to-one technology immersion reform in K-12 schools. This framework provided 14 essential components or conditions that needed to be present in the implementation. The ISTE's 14 essential conditions as adapted for this study are paraphrased in the following enumerated bullets:

1. *Shared vision* as a universal expectation or vision of the integration effort amongst all stakeholders.
2. *Empowered leaders* in which all stakeholders must be given autonomy to effect the change mutually envisioned.
3. *Implementation planning* in which stakeholders follow a systematic plan that includes the immersion of information and communication technology and digital learning resources.

4. *Consistent and adequate funding* involving ongoing funding to support technology infrastructure, staff, and training.
5. *Equitable access* in which all stakeholders must have access to robust and reliable connectivity as well as updated devices, software and networks.
6. *Skilled personnel*, meaning educators and support staff have up to date information about the latest innovations and implementation methods.
7. *Ongoing professional learning* through which educators have access to on-demand professional development as well as time dedicated to implementation.
8. *Technical support* enabling educators and students to have access to support for the technological resources they use.
9. *Curriculum framework* as a system of retooling the desired standards to support digital age learning and work.
10. *Student-centered learning* as an agile planning and assessment system based on the individual needs of each student.
11. *Assessment and evaluation* involving processes and products that are consistently evaluated and assessed.
12. *Engage communities* by informing the broader community on the demands required of today's learner and forming partnerships to enhance the integration.
13. *Support policies*, meaning policies, financial plans, accountability targets and incentives that support the digital learning environment.

14. *Supportive external context* in which structural, political support at the local, state and national levels for the implementation of the digital learning environment exists.

These 14 critical elements formed a diagnostic tool to assist public school districts' leaders in guiding their schools' one-to-one integrations. Districts and campuses could use the tool to assess their readiness and abilities before and during the integration process (ISTE, 2016). Furthermore, the ISTE's (2016) conditions model could be used collaboratively with the Future Ready Schools (2015) model.

Figure 1 displays the interrelatedness of the two models. First, the inner circle of the graphic includes Future Ready Schools' (2015) seven concepts in clockwise order from orange top icon as budget and resources (orange icon); use of space and time (green icon); curriculum, instruction, and assessment (light blue icon); robust infrastructure (red icon); data and privacy (green icon); community partnerships (gray icon); and personalized professional learning (dark blue icon). The ISTE's (2016) emphasis on empowered leadership appears as the overarching circle encompassing all aspects of implementing the dually adapted model. Via empowered leadership, stakeholders' actions enable all the Future Ready Schools' concepts to be implemented synergistically. The grey colored secondary circle of sharing the vision, planning, and assessing the program's implementation encompasses the remaining conditions from ISTE's (2016) essential conditions. By integrating all the ISTE conditions in an implementation of one-to-one technologies, the Future Ready Schools framework can be successful.

Figure 1. Interrelatedness of the models of technology integration developed by the ISTE and Future Ready Schools.

The study was grounded theory using a case study oriented. The case study was bounded by two high schools and the central office administrators of a K-12 public school in Texas with one-to-one technology implementation. Central to this study was the necessity to collect central office administrators', principals', and teachers' perceptions of how the instructional leadership culture of a school campus is aligned for promoting or thwarting the successful integration of mobile technologies into teachers' instructional practices.

Definition of Terms

In order to better understand the study and related context, some elaboration of the terms is necessary.

Digital citizenship: Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior (ISTE, 2016). Also defined as the ability to think critically, behave safely, and participate responsibly in the digital world.

First-order change: Reforms that are accomplished within the confines of existing organization goals and structures. Corrections to deficiencies in policies and practices create efficiencies without disrupting basic organizational arrangements (Cuban, 1988).

ISTE: An acronym used to identify the International Society for Technology in Education.

LMS: An acronym used to describe a Learner Management System. LMS represented a comprehensive software to ensure the development, delivery, communication, assessment, and administration of digital-based courses (Wright, Lopes, Montgomerie, Reju, & Schmoller, 2014).

mLearning: Learning that is personalized, situated, and connected by a mobile device (Romrell, Kidder, & Wood, 2014).

NCLB: An acronym used to describe the No Child Left Behind Act of 2001 (NCLB, 2002). Essentially the update to the Elementary and Secondary Education Act. A collaboration of civil rights leaders, business groups, Republicans and Democrats to

increase the role of the federal government's role in holding public schools accountable for student outcomes (Klein, 2015).

NETS: An acronym used to identify the National Educational Technology Standards (Greaves et al., 2010).

One-to-One: The term used to describe an educational setting in which each teacher and student has been provided a personal computing device for educational use at school and at home.

Project Red: A comprehensive national study of effective technology-transformed schools. Scope of the study included both best practices and cost savings (Greaves et al., 2010).

SAMR: A common model used for technology integration that includes a level of depth and complexity through substitution, augmentation, modification and redefinition (Puentadura, 2013).

Second-order change: A fundamental break with past and current practices. Requires new knowledge and skills as well as a significant break from previous goals and policies (Cuban, 1988).

Shared vision: An effective vision is accomplished when the activities of the of the mission is clearly defined by the people within the organization (Yukl, 2013).

Limitations

The structure of the narrative for the case study approach provided a challenging and isolated research use (Creswell, 2007). Information about the participants needed to be understood from a broader context than simply the interview, which necessitated

extensive information gathering about the participants to help elucidate the context of their responses and the subsequent findings. Furthermore, the findings of qualitative case study research are bounded by the context of the study; thus, researchers are generally hesitant to generalize the findings from case study research (Creswell, 2007). The researcher provided thick, rich descriptions to better ensure the transferability of the findings (Merriam, 2009).

The community perspective was only shared through the selected employed staff thereby limiting the scope of the findings. Additionally, the school district site served an uncharacteristically high number of economically disadvantaged students. The number of teachers willing to participate was a limitation to the study as some of the faculty present at the onset of implementation might no longer have been employed in the school district. Readers must make the final transferability decisions regarding the outcomes of the study.

Delimitations

This single case study was restricted to one school district in Texas in an urban setting with more than 80,000 students. The fact that a single school district was studied enabled the researcher to interview teachers and staff who had shared experiences. The perspectives from adult staff including administrators and teachers who implemented the whole school reform represented the bulk of the data. This study did not include students.

Assumptions

The assumptions in this study were limited to three main points of focus. First, the researcher assumed that all interviewees were truthful and transparent when answering questions. Second, the researcher assumed that one-to-one technology implementation had the potential to produce successful student achievement outcomes and the implementation process might assist in maximizing these outcomes. Finally, the researcher assumed that the one-to-one technology immersion process was part of a whole-school reform model.

Significance of the Study

Public school districts throughout the nation are currently implementing or considering implementation of one-to-one computing. Methods of implementation have been varied as have the success levels of the initial studies of technology implementation. This study provided other districts with a framework to help guide them through the process and implementation of one-to-one computing. The study was significant because enormous monetary resources have been expended on one-to-one initiatives, and very few successful models of implementation exist in research. The study informed educational leaders about the best practice strategies needed for implementing professional development as well as program deployment and sustainability of the resources required for a successful initiative.

The Organisation for Economic Co-operation and Development (OECD, 2017) found that the United States ranked 17th in reading and 20th in science with no trending data to suggest any changes to that statistic would occur in the near future. These types

of data points suggested the need for innovation in public education in this country. Technology rich resources may very well enable the next educational revolution.

A new era of learning is on the near horizon, and technology related resources are in the forefront of this transition. Real time student data and artificial intelligence provide personalized resources to both teachers and students. Teachers, students, and parents have access at their fingertips not only to educational gaps and limitations within the curriculum but also student interest inventories, research based pedagogy, and open resources. This study might, therefore, enable policies to be generated that benefit school districts, students, parents, and communities.

Summary

Chapter One addressed the problem for study and indicated the purpose. The purpose of this study was to discover what policies, actions, and experiences contribute to the successful implementation of a one-to-one student technology initiative in a K-12 public school district. The theoretical framework was discussed as built upon the tenants of two technology integration models. Several factors thought to impact the study included the complex interactions of vision, leadership, curriculum, pedagogy, professional development, technical support, funding, and communication. The perceptions of teachers, campus administrators, and executive administrators at the central office level allowed the researcher to garner data related to participant experiences within the social context of the case study via a grounded theory approach (Willis, 2007). The specific event in relation to this study was the integration of mobile, one-to-one technology available to every student in grades K-12. The identified case was an urban

school district that experienced successful student achievement as evidenced through standardized tests results and had implemented one-to-one technology. Chapter Two provides the review of the literature pertinent to conducting this case study.

CHAPTER TWO: REVIEW OF THE LITERATURE

Society's expectations for results have increasingly called for real-time, immediate solutions to age-old problems. From cancer to bullying, society demands solutions now. Public education is not immune to this expectation, and stakeholders' calls for a more agile and better-educated workforce have been answered by reforms aimed at rethinking traditional methods of teaching and learning. Nothing has changed more rapidly in the past 20 years than technology, and through this medium, much of the expectations for better school systems have emerged.

Simple software systems have included grading programs and attendance software and represent some of the first examples of technology to find their way into the nation's educational environments. Many of these systems helped forge more efficient schools but was this emerging efficiency leading to better teaching and learning? The call for improvement to the nation's educational system could not simply be found through greater time management, but rather by changing the way teaching and learning occurs both inside and outside the classroom (Sheninger, 2014). This is where technology implementation facilitates the pedagogical change needed to develop a workforce that can adapt to the challenges of preparing for jobs that do not yet exist.

Changes in the pedagogy of public education must be grounded in 21st Century Skills (Sheninger, 2014). Skills that enable the learner to personalize their development by making the content relevant to their unique interests, while simultaneously guiding a method of learning allowing for synthesis, critical thinking and problem solving. Where does technology fit into this new world order of public education? This chapter contains

the survey the literature related to the implementation of one-to-one computing initiatives in schools across the nation.

Overview of One-to-One Computing Initiatives

This section outlines the background and history of one-to-one computing initiatives, including an explanation of Project Red, the first large-scale national study to identify and prioritize the factors that contributing to the success of U.S. K-12 technology implementation initiatives. Although this study involved examining the processes and implementation strategies that enable a successful one-to-one mobile computing initiative, the review of literature was inclusive and contained an array of initiatives in addition to one-to-one computing initiatives aimed at placing technology in the hands of students.

History of Technology in Education

Beginning with NCLB in 2002 technology implementation in public schools has been a focus of an enormous number of stakeholders. Federal and state governments, school administrators, teachers, parents, and community members have all weighed in on the academic benefits of harnessing the global power of technology as a tool both inside and outside of the classroom (Coley, Cradler, & Engel, 1997). Buzz terms or jargon, such as *real-time assessments*, *project based learning*, and *one-to-one initiatives* have become commonplace in the schools served by most practitioners and stakeholders.

Scholastic expectations for schools today are that they not only teach the fundamental reading and writing and arithmetic but also immerse students in 21st century skills that include critical thinking, problem solving, collaboration, imagination, and

global awareness (Wagner, 2008). As a strategy to enable students to become technology literate, many schools have implemented *one-to-one initiatives*. For the purpose of this study, the definition of a one-to-one initiative was limited to initiatives that allow all students in a grade span, such as every high school student on campus or all ninth and 10th graders, to use a school-provided laptop or tablet computer.

One-to-One Student Computing Initiatives

One-to-one technology initiatives began in the mid-1990s, but research in this field has been lacking as devices, software, and information continue to evolve, and many studies' samples were not large enough to provide a strong statistical analysis (Moersch, 2014). In 2001, Penuel et al. reported that scholarly research related to one-to-one technology in education was scarce and that existing studies were of weak quality and had methodological problems. Five years after his initial study, Penuel (2006) identified 46 implementation and outcome studies addressing one-to-one programs. The number of studies increased in large part due to the growth of initiatives in the United States. Maine, Indiana, Michigan, and Virginia implemented state initiatives studied by Lemke and Martin (2003, 2004a, 2004b, 2004c). In those studies, Lemke and Martin began framing one-to-one initiatives into phases that addressed mission and scope, implementations processes, impacts to student learning, and locales' responses to initiatives.

Project RED

The most comprehensive assessment of best practices in today's public schools was documented in the Project RED study (Greaves et al., 2010). Greaves et al. (2010)

insisted that a direct relationship between higher academic achievement and one-to-one technology integration exists. They found financial savings to be a beneficial aspect of such initiatives.

Previously, Greaves and Hayes (2008) identified that only 33% of school districts with one-to-one technology initiatives showed significant academic growth. Therefore, Greaves et al. (2010) in Project RED surveyed several thousand schools to ask what actions enabled successful educational technology integration. The Project RED conclusion was that in many cases, double digit improvement in student achievement could occur (Greaves et al., 2010). They argued they key to a successful implementation process which yields academic gains among students involves using a model of technology immersion. The Project RED researchers described the process as operating in two phases identified as first-order and second-order change that are discussed comprehensively later in the chapter. Consequently, the role of one-to-one initiatives in academic success has also been investigated.

Improving Academic Achievement

Numerous studies have been conducted on the effects of one-to-one initiatives in public schools (Hu, 2007). Many studies have shown that these initiatives do not have a positive impact on student achievement, leading many schools to cancel their one-to-one technology programs because of lack of academic achievement gains. Although these studies provided some evidence of poor implementation, numerous examples of successful one-to-one initiatives offer evidence of student achievement gains in writing, literacy, science, exam scores, and GPAs.

One of the most comprehensive studies of the academic achievement of one-to-one initiatives was documented in a statewide study in Maine (Silvernail & Gritter, 2007). Every middle school student in Maine was issued a laptop computer for school and home use. Significant achievement gains in the content area of writing on the state assessment occurred because of the laptop initiative. Silvernail and Gritter (2007) concluded that students who use the devices more extensively produce higher achievement scores.

Lowther, Ross, and Morrison (2003) also found a positive correlation between writing scores and students who had laptops. A control group was not issued laptops while another group was given 24-hour access. Other studies related to writing have produced similar results. Suhr, Hernandez, Grimes, and Warschauer (2010) found fourth grade students in a one-to-one technology program attained gains in both literacy and writing skills. Students of both the intervention and control groups achieved significant gains in literacy response and analysis as well as in writing strategies. Gains were reported to be more dramatic in the second year of the study.

In the areas of math and science, less evidence of significant student achievement has been observed; however, Dunleavy and Heinecke (2007) found in a middle school study, students showed positive gains in science achievement. Conversely, they also observed students immersed in the one-to-one laptop initiative did not show significant increases in math achievement.

Although much attention has been focused on standardized test scores as a correlation to student academic achievement, Lei and Zhao (2008) looked at the positive

results on grade point averages in relation to one-to-one initiatives. Middle school students' end-of-year grade point averages improved from the previous end-of-year grades when students had laptops. Lei and Zhao found students attained marginally significant gains in grade point averages but observed significant gains in students' technological proficiencies. Similarly, Gulek and Demirtas (2005) found students earned substantial gains in their GPAs, specifically in the content areas of reading, writing, and math, as well as on state and school district tests, because of a one-to-one initiative (Gulek & Demirtas, 2005)

National Educational Technology Standards

ISTE (2011, 2016) defined a series of frameworks for technology integration and infusion in public school environments. ISTE provided standards and performance indicators for administrators, teachers, and students. Those standards and indicators appear next.

Administrators

Visionary leadership tops this list of standards for administrators and is defined by actions that inspire and lead development and implementation of a collaborative vision for technology integration (ISTE, 2016). Shared visions are built that incorporate timelines, expectations, and measurement of implementation. Leaders are expected to advocate for the integration of technology into the learning process on the local, state, and national levels.

Cultural change is also important to the leadership process by realizing an environmental change that provides a rigorous, relevant, and engaging teaching and

learning environment (ISTE, 2016). Tenets of this process include a dynamic, learner-centered environment that meet the needs of diverse learners. This culture leads to an environment that promotes professional learning that is as important to the teacher as it is to the learner.

Systemic improvement is the final principal defined by the ISTE standards for administrators. Through systemic change opportunities for collaboration within the system allow for a dynamic environment that reaches outside of the traditional school walls to provide resources through partnerships with corporations, educational agencies, and educator groups. This systemic change also enables an inclusion of digital citizenship into the curriculum of the school.

Teachers

Expectations for teachers in the context of the ISTE standards are imbedded in the model of teacher facilitation. Teachers become facilitators of a relevant experience for students by using their content knowledge as well as their expertise in the teaching and learning process. Student creativity is promoted in a way that keeps students engaged in the curriculum and motivated to find solutions to authentic problems using digital devices. Blended learning is also encouraged to break down traditional learning norms and enable students to find resources and communicate outside the confines of the school day (Hew & Cheung, 2014). Teachers model the need for this practice and become resources through digital means. Horn and Staker (2011) promoted blended learning opportunities to force over half of high school courses to be online by 2019.

Teachers are further challenged by the ISTE standards to design and develop new and improved digital-age learning experiences and assessments that promote and model digital citizenship and responsibility. Ribble (2008) outlined the need for a strong focus on digital citizenship and for students to understand human, cultural, and societal facets through technology use. Legal and ethical behavior have never been as important in the curriculum as today due to increased need for technology within the curriculum.

Students

ISTE (2011) divided student-oriented proficiencies, or standards, into five categories. Those categories are the following: (a) creativity and innovation; (b) communication and collaboration; (c) research and information fluency; (d) critical thinking, problem solving, and decision-making; and (e) digital citizenship. Each of the five categories are discussed in the following paragraphs.

Creativity and innovation. Students focus on using creative thinking, constructing knowledge, and developing innovative products and processes using technology. ISTE (2011) promoted the following for how students demonstrate creativity and innovation:

a. Use current knowledge to generate new ideas, processes, or outcomes
b. Produce original products for personal or group expression
c. Create models and simulations for discovering multipart systems and topics
d. Classify trends and predict possibilities.

Communication and collaboration. Students focus on using digital media and environments to communicate and work collaboratively, including at a distance, to

support individual learning and contribute to the learning of others. ISTE (2011) promoted the following for how students demonstrate communication and collaboration:

a. Cooperate, collaborate, and produce outcomes with peers and teachers via several media and technologies
b. Communicate knowledge and thoughts effectively to their audience via a variety of technology tools
c. Produce cultural understanding and awareness about cultures across the globe by interacting with students from diverse cultures
d. Participate in teams that generate solutions to problems or creative products

Research and information fluency. Lei and Zhao (2008) found that students in one-to-one initiatives used their issued devices to expand their research base and search for information in a variety of ways. With this competency, students focus on applying digital tools to gather, evaluate, and use information. ISTE (2011) promoted the following for how students demonstrate research and information fluency:

a. Develop purposeful tactics to channel exploration of knowledge
b. Find, categorize, evaluate, blend knowledge from multiple sources, and use information in an ethical manner attained through several formats of sources
c. Choose appropriate sources of information and technologies for specific tasks
d. Generate data and reports from data analysis

Critical thinking, problem solving, and decision-making. Students focus on using critical thinking skills to plan and produce research and products, solve problems, and choose how to move forward with appropriate digital tools and resources. ISTE

(2011) promoted the following for how students demonstrate critical thinking, problem solving, and decision-making:

a. Identifying and defining authentic problems and significant questions for investigation;
b. Planning and managing activities to develop a solution or complete a project;
c. Collecting and analyzing data to identify solutions and/or make informed decisions; and
d. Using multiple processes and diverse perspectives to explore alternative solutions.

Digital citizenship. Students focus on understanding human, cultural, and societal issues related to technology and practice legal and ethical behavior (Ribble, 2008). ISTE (2011) promoted the following for how students demonstrate digital citizenship:

a. Behave safely, responsibly, and legally when using technology for gaining knowledge
b. Display a positive attitude about technology and support production of knowledge with collaboration
c. Exhibit personal responsibility to produce lifelong learning
d. Be a leader and model digital citizenship

Technology operations and concepts. Students focus on demonstrating a sound understanding of technology concepts, systems, and operations. ISTE (2011) promoted the following for how students demonstrate technology operations and concepts:

a. Comprehend technology systems and use them

b. Choose technology applications effectively and use them productively

c. Solve technology-related problems

d. Transfer learned concepts between technologies

Student Use

One of the most prevalent criticisms of technology implementation in public schools has been the belief promoted by Cuban (2001) that technology is oversold but underused. Critics, like Cuban, stated that exorbitant amounts of public investment dollars have been infused into technologies seldom employed in classrooms by teachers and students. Researchers have specifically addressed this criticism through several studies related to student use (e.g., Ritzhaupt, Dawson, & Cavanaugh, 2016; Jenkins, 2009; Lei & Zhao, 2008; Shirky, 2008). Indeed, quality of use was perceived to be more important than quantity of use in the research.

Lei and Zhao (2008) found that student use of computers was significantly increased with a one-to-one initiative. They noted that 36.9% of students surveyed in their study spent more than three hours on their devices per day while another 30.8% of the students spent between two and three hours a day immersed in technology. Lei and Zhoa's research question was: If students were using technology more, were they using the devices in a constructive learner centered way? A follow up survey was conducted by Lei and Zhao to gather evidence of types of use.

Lei and Zhao (2008) found that 81.4% of the students used their laptops to complete homework assignments, 71.4% to search for relative information pertaining to school assignments, 65.8% to receive and send emails, and 51.1% to chat with others

online. About half of the students admitted to playing computer games. Lei and Zhao generally found that the laptops issued to the students were most commonly used for learning purposes. Lei and Zhao found the specific activities practiced on students' technology devices included note taking, word processing, and accessing all notes available.

Ritzhaupt et al. (2016) studied 107 campuses in 17 school districts in the state of Florida. They found that teachers' use of technology positively influenced the frequency of student use. Ritzhaupt et al. depicted student use of technology as tied to teachers' methods for integrating technology into learning. Previously, Jenkins (2009) and Shirky (2008) found that putting technology into the hands of students produced multiple educational benefits, such as students experiencing support for creating, communicating, and collaborating as well as students developing higher order thinking skills and improved achievement scores at higher rates in many content areas.

Overview of Implementation Factors

A review of the research indicates that factors in the successful implementation of K-12 one-to-one computing initiatives include first-order change, second-order change, technical preparations and funding and sustainability.

First-Order Change

Mastering the change process in any organization is extremely difficult and the challenges relating to public education institutions are numerous. Most schools have practiced a direct teach model for generations and changes to this instructional method not only affects those within the organization but entire communities and cultures. These

changes are defined in a two-step process of first-order and second-order change (Greaves et al., 2010).

First-order change is accomplished through basic implementation strategies that simply enable leaders to determine the potential outcomes related to infusing the system with systemic changes in curriculum, instruction, and managerial processes (Greaves et al., 2010). Most educational technology initiatives accomplish the first-order processes, but fail to change the culture of the organization and the educational impact is limited. Cuban (1988) further defined this process by targeting efficiency within the system by addressing basic deficiencies in current practice and policies. The vision, goals, and structures of the organization are accepted as adequate and are not redesigned to meet the new challenges afforded by the immersion of technology that encompasses a "one-to-one" initiative.

Other managerial operations defined as first-order changes include personnel and administration processes directed to increase the capacity of the organization by hiring quality teachers and administrators; raising salaries; redistribution of resources; selecting improved texts, materials, and supplies; and restructuring content and course offerings (Cuban, 1988). These transitional activities often allow for the appearance of fundamental change, but accomplish little to initiate the transformational change that the organization must have to accomplish the goals envisioned of fundamentally changing the teaching and learning of staff and students. These changes often are disruptive and administrators allow some autonomy in staff practices in hopes of reestablishing a comfortable climate in the organization.

Second-Order Change

Second-order change is more complex and implies a shift from the current and past practices. Second-order change infuses the organization with fundamental changes in educational practices that require new knowledge and skills to accomplish the desired successful implementation (Cuban, 1988).

Project RED defines second-order change through measurable outcomes of student achievement and cultural practices found within the organization (Greaves et al., 2010). Expectations for student achievement are that summative performance assessments must enable increases twice the previous levels attained through the traditional methods. Evidence of learning practices that affect all student populations at all levels of comprehension must also be accomplished to depict evidence of second-order change. Second-order change must also be replicable to other sites and the largest of educational entities. Finally, the changes must also be sustainable regardless of the institutional challenges that occur over time including economic instability and staff turnover.

Project RED also provided several examples that evidence second-order change within an organization such as personalized instruction, focus on demonstrated proficiency in lieu of seat-time and a pervasive focus on the student as the customer (Greaves et al., 2010). Project RED data provide evidence that improvements in academic-success measures and financial return on investment are solely tied to second-order change. Greaves et al. (2010) also indicated that second-order change within an

educational organization may be impossible to achieve without a student-computer ratio ensuring one device per student.

Technical Preparations

The main considerations when moving to a one-to-one environment include type of device, network reliability and functionality, and opportunity for sustainability. Those considerations are explained in the following paragraphs.

Device types. Device selection is an important decision but not the driving factor for successful one-to-one initiatives. Whether schools choose notebook computers, tablets, smartphones, or other handheld devices, the access to information is the key to the environment. Roscorla (2012) approached the technology decision by using functional criteria. Roscorla argued that a device must allow users to create eBooks, videos, and presentations. Sharing the screen and information found on the device seamlessly with teachers and students, printing, making notes, and annotating files using different mediums as well as using cloud-based storage are all part of his criteria. Roscorla added that the device must facilitate independent learning and learning goals by answering questions such as "Does the device allow students to be exposed to the best, most inspiring content that I can think of?" Many devices and tables meet these criteria.

Reliability and functionality of the network. Five areas must be considered when making the structural and physical hardware purchases to support a one-to-one environment (Motorola, 2010). First, wireless environments must be prepared to support more than one device per student. For example, students may choose to use a second device or phone within the school network as they research or prepare presentations.

Second, the bandwidth must be robust enough to provide a high-speed connection to multiple devices. Some rural and remote areas may not have the existing infrastructure to adequately support initiatives. Third, the network must have adequate space to support more multimedia resources. Faculty and students must be able to access information that is rich in video and audio. Also, decisions must be made regarding how students can access information outside of their schools. Finally, administrative and faculty communication also increase over the schools' electronic network and allow a more paperless environment to grow.

Funding and sustainability. Greaves et al. (2010) noted the emphasis in Project RED involves the importance of sustainability from a different angle than many other studies. Additionally, they concluded that richer technology implementation yields more direct cost reductions and indirect revenue enhancements (Greaves et al., 2010). The budgetary impact of ubiquitous technology implementation is approximately $100 to $400 per student per year. As an outcome, the positive financial impact could be as high as $56,437 per student per year. This number is calculated by accounting for the full impact of career-enhanced returns of tax revenues (Greaves et al., 2010). After 40 years of practice, the financial impact of one-to-one technology introduction could mean an increase in total tax revenues of $3 trillion per year.

Original funding sources for one-to-one initiatives vary by district, but over 72% of Project RED surveyed schools used their operating budgets (Greaves et al., 2010). Another 42% responded that some type of state or federal formula grant was used in part to fund the initiative. Surprisingly, only 22% of the schools found funding through

competitive grants. Greaves et al. (2010) found that 56% of the schools also believe the sustainability of the initiative to be 5 years or more.

In simpler terms, Greaves et al. (2010) estimated that one-to-one high schools with properly implemented learning management systems [LMS] could cut their copy budgets in half. Much like the tax revenue scenario earlier, another major financial impact of an enhanced technological learning environment is high school dropout rate reduction. One-to-one schools have less than half of the number of dropouts than found in the traditional school environment.

Best Practices for Technology Integration in Schools

Enormous investments of public funds have been expended for technological devices to ensure that students are prepared for the 21st century. The effect of these devices on the educational landscape and the subsequent return on investment is routinely called into question. Critics suggest that these devices merely serve the role of an advanced word processor, calculator, or thesaurus. Furthermore, they argue that an over-reliance on many of these tools could lead educational processes toward a negative direction by producing students unable show competency with basic math computation or simple sentence structure (Reeves, 1998). Using technology to change teaching and learning into a more comprehensive life skill requires changing the mindset of the traditional public education system. Moersch (2014) imported many competencies provide the backbone of best practices to move public education forward in the digital age.

Student-directed inquiry. Moersch (2014) describes this component of a digital age best practice as a process that allows students to guide their own inquiry from personal experience to access to information or reconcile dissonance. Students must realize this dissonance through some sort of educational interruption to their worldview. The teacher seeks to engage this inquiry through prompting research on relevant information that may challenge students' original view or provide an alternative answer to a student-generated problem. This method of leading learners provides several outputs, if constructed properly (Moersch, 2014).

The first and most obvious technique requires using in practice actual student-generated questions to drive discussions and inquiry (Moersch, 2014). Also present in this observable process is several teacher-generated focus activities. A complex thinking process and student-directed learning environment happen during this process. The National Academy Press (1996) in the National Science Education Standards described this process by the following:

> When engaging in inquiry, students describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and communicate their ideas to others. They identify their assumptions, use critical and logical thinking, and considering alternative explanations. (p. 13)

Technology facilitated collaboration. Today's learners are immersed in technology and use it to the extent that Prensky (2001) termed this generation of students *digital natives*. Therefore, teachers offer information relevant to problem solving,

research, and inquiry and via a method with which learners are familiar and comfortable. Teacher and students use their network, essentially any digital environment, to share ideas. Siemens (2005) termed the action *cross-pollinating* the learning environment. Learners from homogenous and heterogeneous environments share information on topics relevant to all involved learners. Virtual field trips, for example, allow students to communicate and share their cultures, traditions, economies, and values are made much more meaningful because of the availability of technology. In the most common pedagogical sense this instructional method is defined as *cooperative learning*. This process is most successful when individual learning is recognized and rewarded (Slavin, 1995). When using group goals and individual accountability, a significant positive impact on student achievement occurs (Siemens, 2005).

Technology has allowed for a much larger cooperative learning environment by casting a broader net of learners with similar interests into technological networks. The walls of the classroom or campus no longer bound shared learning and collaboration but allow for inquiry and learning to occur in a much larger context within a network. Learners can now diversify their experiences by reaching out to others worldwide that share their common interests.

Authentic and relevant connections. Content globalization allows for authentic and relevant real-world connections to learning. Herrington, Oliver, and Reeves (2003) identified 10 characteristics of authentic learning that can be practiced across curricular areas. Those 10 characteristics are paraphrased and explicated in the following paragraphs.

1. Activities need to match real-world tasks had by professionals in the field, if possible. Textbook-based learning alone does not achieve this goal. Learning achieves a level of relevance when students are engaged in abstract concepts, facts, and situations inside realistic and real-world situations.
2. Activities must enable students to solve ill-defined problems. Problems and challenges cannot simply be solved with applications of prevailing processes. The pathways to solutions are open ended and defined by learners' individualized efforts.
3. Learning must have multiple steps and require sustained investigation. Answers to problems require authentic activities that call for in depth investigation over a sustained period. Problems that can be solved during one class period or within a week do not teach students to have the competency for sustained investigation.
4. Tasks require learners must use multiple sources and acquire diverse perspectives. Learners must seek the information for themselves, however. These activities enable students to distinguish relevant from irrelevant information.
5. Learners must collaborate on the work at hand. The solution is not achievable by individual work. Collaboration is needed to achieve competent communication skills for the real-world application of the project or activity.
6. Reflection of the activity is required for achieving authenticity. Learners must have some structure to contemplate their choices toward developing the

outcomes of the activity or challenge. Reflection promotes learning to allow students to more effectively solve problems encountered in the future.

7. Learners must exercise an interdisciplinary perspective. Authentic activities have outcomes and consequences that extend beyond the original discipline.
8. Assessments are integrated into the activity. Assessments are not necessarily summative in nature but are woven seamlessly into the major task in a way that mimics real-world applications.
9. Learning produces a finished product. The activity process enables students to produce a whole, complete product that stands alone. Without a fully complete outcome, students may lack the ability to understand that their efforts have value and can be appreciated by the end user or evaluator.
10. Activities require opportunities for drawing multiple conclusions or envisioning, if not producing, diverse outcomes. A single, correct output does not suffice when developing authentic activities. Multiple solutions may be appropriate or correct for solving the problem, completing the activity. Therefore, problems are solved by original thinking and via multiple pathways.

These 10 tenets provide a strong foundation for assessing the quality of the lessons provided via a digital context to students. Authentic connections and student-directed inquiry, although identified separately in the research, provide a powerful combination of engaged learning when combined. Lombardi (2007) furthers the call for authentic and relevant learning experiences by building on the *doing*, rather than the

listening, approach that students and teachers alike agree is more successful. This pedagogy cuts across multiple disciplines and depicts real world scenarios for age old curriculum requirements. For example, learning about physics requires a vastly different approach to gaining knowledge than the actions involved in learning to be a physicist. Applying the content studied in class promotes the objective of enabling student to meet the expectations had by real-world employers, customers, clients and colleagues. Further, hands-on learning activity promotes gaining a stronger understanding of the concept while preparing the learner for the challenges of a 21st century workplace.

Project-based learning occurs via technology applications and enables a student-centered learning environment that allows for differentiated instruction by combining authentic connections and student-directed inquiry. Individual students' needs, interests, and levels are addressed in a differentiated learning environment. Teachers address student differences in terms of horizontal (e.g., student interests, learning modalities) and vertical (e.g., student reading and/or skill levels) growth (Moersch, 2014). This method also permits teachers to adjust elements of the curriculum to match students' needs during collaboration within the learning process and because of one-to-one technology.

Teachers must be grounded in research-based strategies that enable differentiated instruction such as tiered instruction, personal agendas, anchor activities, learning contracts and flexible grouping (Moersch, 1995). They also must be adept in practices using digital resources that promote differentiation. Teachers must be able to navigate wikis, blogs, interactive applets, simulations, and many other digital resources to fully utilize differentiation strategies. One method of differentiation is the method known as

LoTi (Levels of Teaching Innovation), which enables teachers to deliver lessons at multiple instructional levels. Moersch (1995) describes LoTi as a process that allows for graduated levels of teaching practice with different levels of authenticity, complex thinking, student-centeredness, and technology use, as the teacher moves from a lower level to a higher level of teaching innovation via available tools and resources.

Tools and resources. Many one-to-one initiatives encounter numerous challenges by simply becoming branded solely by the device. As noted earlier, many early studies were critical of the infusion of individual technological devices. Many educators, legislators, and stakeholders believed that more technology would equate to more learning. Successful technology immersion projects have been focused on changing the teaching and learning environment rather than simply using the new devices. Roschelle, Pea, Hoadley, Gordin, and Means (2000) found that technology can enhance both what and how children learn when coupled with activities that anchor learning by requiring active engagement, participation in groups, frequent interaction and feedback, and connection to real-world contexts.

Anchoring student understanding with formative assessments. The use of formative assessments to guide instructional practices is not new to fundamental best practices in education. Teachers assessed student understanding both formally and informally for much of the greater part of the 20th century. Leading the research of formative assessments, Black and William (1998), defined the process as formative only when the assessments lead to the adaptation of the lesson to meet the needs of the students. Recently the structure of formative assessments has been enhanced with the

infusion of technology. Digital tools have enhanced the practice and need for formative assessments to provide a reflective nature of learning that promotes the individual achievement of each student.

Formative assessment practices are directly linked to 21st century skills by equipping the learner with the skills that promote flexibility, adaptation to change, and self-directed learning (Partnership for 21st Century Skills, 2011). Students gain abilities to deal positively with praise, criticism and failure. Students transform into life-long learners able to self-assess situations and problems that lead to change and opportunity for future progress.

Creating Student-centered Learning Environments

Moersch (2014) defined student-directed learning environments by the infusion of student choices into the teaching and learning process. Students are given more freedom to choose the topics and outcomes of assignments than in a teacher-centered instructional environment. This adaptation from the traditional learning environment is difficult for educators whose previous experiences were grounded an educational process based on teacher led lesson plans.

Moersch (2014) explicated student-centered learning as needing the three components of *content*, *process*, and *product*. Content is often tied back to some defined standard, whether found locally, statewide, or nationally, that provides the learner a structured goal around which lessons are planned. Process is the action of learning the content by means of research, collaboration, analysis, and problem solving. Finally, product provides students with the opportunity to demonstrate content mastery. When

guiding this practice, teachers encourage students to engage in discussions exceeding those provided by the teacher, to negotiate expectations between the teacher and student, and to use of numerous instructional strategies and resources. However, teachers cannot create student-centered learning environments without leadership.

Principal Leadership

Almost all successful school reform efforts start and end with strong leadership. Robert Farrace, senior director of communications and development with the National Association of Secondary School Principals stated in an interview with Demski (2012) that the primary role of today's principal is to model innovative behavior. Many studies have provided documentation emphasizing the importance of school leadership in the transformation of the one-to-one learning environment. In Project Red, for example, Greaves et al. (2010) noted the four fundamental areas that enable campus leaders to transition away from the traditional school framework and into digital-age best practice environments are instruction, cost savings, policy, and industry (Greaves et al., 2010).

Instructional Leadership

The instructional leaders must meet the need for teacher training and development. Even though principals tend to be the primary instructional leaders of their campuses, instructional leadership encompasses a much broader context. Traditionally, the campus building principal has been responsible for evaluative procedures and methods designed to focus on teacher delivery of content and student engagement as a result of direct instruction, but building principals also have limited levels of subject-area

content and focus on teachers ensuring students develop a measurable level of success, such as on a statewide exam.

Instructional leadership has changed over the years and now encompasses a more comprehensive level of peer participation enabling more of a shared leadership environment (Moersch, 2014). This collaborative instructional environment enables teachers and administrators to work together to provide goals, expectations, and a culturally meaningful vision of learning. The principal, although no longer the sole individual responsible for the instruction process, must transform similarly with teachers. They must become facilitators of the transformational process that is necessary to the implementation of a successful one-to-one initiative. Moersch (2014) argued that they engage the *5Cs of instructional leadership* as they effectively guide the school during the successful one-to-one integration process. These five areas include cultivation, courage, creativity, commitment, and communication.

Courage. Many public school leaders provide a vision of transforming traditional school systems into traditional one-to-one, digital best practice environments. These leaders clearly see the need for change and what that change would encompass; however, many of these leaders do not cultivate an environment that is conducive to this transformation (Moersch, 2014). Often a viable, realistic plan of action is missing in these schools, and this lack of leadership structure can foster an environment that is resistance to the vision that the leader possesses. Successful one-to-one initiatives are steeped in simply incorporating digital devices into a larger call for comprehensive school improvement.

Creativity. The second attribute that is central to the successful instructional leader is creativity. The instructional leader is open minded about the environment and brainstorms, tries new things, recognizes failure, and adjusts quickly. The creative leader sees opportunities in the obstacles that appear and ignores naysayers (Moersch, 2014).

Commitment. These leaders stay committed to the enterprise and to the larger mission of educating children for success beyond school. They do not divert from their action plans even when they are pressured not to change established norms. Moersch (2014) related the need to get ahead of the direction of the group-think and anticipate challenges when committed to doing the right thing.

Communication. As a cornerstone for effective teaching and learning, the principal shoulders the task of continuously sharing the school's central mission. Continuous communication requires quality, daily interactions that are both formal and informal interactions with all teachers, staff, and students, rather than weekly via an email, a brief intercom announcement, or short speech at a faculty meeting. Moreover, communication of mission starts with the principal, but quality communication requires participation by all school stakeholders (Moersch, 2014). Therefore, communication that is continuous needs to involve integrated technologies.

Technology Integration Models

This section of the literature review presents four distinct integration models that are being used today. These models account for various aspects of a mobile technology integration reform effort. The following are the four models of implementation: (a) SAMR (Substitution, Augmentation, Modification and Redefinition) model, (b) ISTE's

essential conditions, (c) TPACK (Technological Pedagogical Content Knowledge) paradigm, and (d) Future Ready Schools' framework.

SAMR Model

One of the first technology integration models to gain prominence in the mobile technology immersion movement was the Substitution, Augmentation, Modification, and Redefinition, or SAMR, model (Puentedura, 2006, 2013). Puentedura (2013) designed the model as a method of evaluating the use of mobile devices and how they have been used to transform the teaching and learning process. Puentedura argued that the use of technology is divided into two categories that enable the learning environment to be enhanced or transformed. Within the basic framework of enhancement, the substitution level allows technology to serve as a direct tool substitute with no true functional change while augmentation allows technology to serve as a substitute but with functional improvement. In substitution, teachers provide visual aids via the use a large touchscreen computer rather than a static overhead. For example, students can interact with an application like Google maps to identify geographic areas rather than simply using a wall mounted map. Transformation is divided into modification in which creative projects transpire via technology because of significant task redesign and redefinition that allows for previously unconceived tasks such as LMS feedback and grouping.

Romrell et al. (2014) researched the evaluative effects of the SAMR model at the higher education level and found that if enhancement was the only product of a one-to-one environment then the risk may not be worth the reward. However, pedagogy has expanded on through transformation mobile technologies become an important part of the

process. This expansion led Romrell et al. to determine one-to-one technologies may very well be worth the challenges associated with full integration.

ISTE Essential Conditions

ISTE (2016) designed some basic required conditions that are necessary for generating one-to-one technology immersion reform. This framework provides 14 essential components or conditions that need to be present to guide implementation. The conditions are briefly reiterated below (and previous discussion may be seen in Chapter One's theoretical framework).

1. Shared vision: A universal expectation or vision of the integration effort amongst all stakeholders.
2. Empowered leaders: All stakeholders must be given autonomy to affect change and attain the mutually imagined vision.
3. Implementation planning: Stakeholders follow a systematic plan that includes the immersion of information and communication technology and digital learning resources.
4. Consistent and adequate funding: Schools retain ongoing funding to support technology infrastructure, support staff and training.
5. Equitable access: All stakeholders have access to robust and reliable connectivity as well as updated devices, software, and networks.
6. Skilled personnel: Educators and support staff are aware of the latest innovations and implementation methods.

7. Ongoing professional learning: Educators have access to on-demand professional development as well as appropriate time to dedicate to implementation.
8. Technical support: Educators and students have access to support for the technological resources they use for coursework.
9. Curriculum framework: The school has a system for retooling the desired standards to support digital age learning and work.
10. Student-centered learning. The school has an agile planning and assessment system designed for meeting the individual needs of each student.
11. Assessment and evaluation: Processes and products are consistently evaluated and assessed.
12. Engage communities: By informing the broader community on the demands required of today's learner and forming partnerships, schools enhance technology.
13. Support policies: The school has policies, financial plans, accountability targets, and incentives to support the digital learning environment.
14. Supportive external context: Structural political support at the local, state, and national level for the implementation of the digital learning environment exists.

These 14 critical elements compose a diagnostic tool to assist public school districts in guiding their school technology improvement and integration efforts. Districts and campuses use the tool to assess their readiness and ability for technology

implementation before and during the technology integration process (ISTE, 2016). The final model appears next.

TPACK Paradigm

Another more commonly known model for school improvement via technology integration is TPACK, or technological pedagogical content knowledge, by Koehler and Mishra (2009). Their observations of teachers collaborating and designing online courses led them to create the TPACK framework. TPACK is composed of the following seven knowledge types: Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK).

Both practitioners and researchers alike have adopted the TPACK framework. Baran, Chuang, and Thompson (2011) developed a model for program development. Abbitt (2011) used the framework to measure and understand the communication between factors relating to technology integration.

Future Ready Schools Framework

The final model identified in this study was developed by Future Ready Schools (2015). This framework is a product of the Future Ready Schools movement for engaging the public school district leaders throughout the nation. By engaging thousands of school leaders, Future Read Schools has worked to accelerate school transformation toward effectively using digital learning strategies. Future Ready Schools represents a coalition supported by the Alliance for Excellent Education and the United States

Department of Education. Future Ready Schools defined seven fundamental gears necessary for digital learning integration that are paraphrased below:

1. *Personalized student learning* is student-centered within which instruction is designed to prepare the learner for college and career readiness. Individual learning plans enable students to have self-paced progress that is measured toward goal of curriculum mastery.
2. *Curriculum, instruction, and assessment* includes the richness enabled by technology in the teaching and learning process. Data are generated in real-time and used to enhance and pace progress toward the learning objectives.
3. *Use of space and time* moves learners away from a 5-day week with the 7 hours per day traditional bell schedule. Students may learn at any time of day whenever time allows, and concept mastery guides the learning process rather than time on task.
4. *Technology and infrastructure* provides system checks for reliability of devices, availability of network resources and cyclical replacement and upgrade plans.
5. *Data and privacy* require secure and private networks and data systems to be central to a technology-rich learning environment. Policies and procedures are also addressed in this gear.
6. *Community partnerships* enable a goal of producing a 21st century learning, which requires providing a more relevant curriculum that addresses the needs to today's workforce. Schools and industries utilize opportunities to work

together for enhancing the learning experience as well as graduating fully educated workers.

7. *Personalized professional learning* is often referred to as involving the digital PLC and allows for teachers and administrators to work toward strong instructional processes by providing specific training and feedback via technology aided tools.
8. *Budget and resources* allow for flexibility in funding, identifying additional resources, and examining areas for cost savings in a technology rich environment.
9. *Collaborative leadership* is steeped in a culture of innovation that allows teachers and students to take risks in order to enhance the learning environment.

Professional Development Using Instructional Technology

Collaborative leadership offers an avenue for ensuring professional development within the context of PLCs. However, the literature contains very few studies focusing on the effects of professional development activities on student achievement. Most professional development oriented studies have been qualitative, focused on participants' satisfaction, or on teachers' self-efficacy levels rather than on actual student improvement gains that may occur due to the activities that occur because of one-to-one technology integration. Gaytan and McEwen (2010) identified the different characteristics of the professional development activities designed to enable teachers to use instructional technology by reviewing practices found in the literature. Gaytan and McEwen sought to

develop a model of professional development that could produce a high quality, effective program through content analysis and examination of several professional development activities that attempt to incorporate technology into high level of instructional activities. Gaytan and McEwen found that perceptions and teacher knowledge were the central components related to evaluating instructional technology and professional development. Many of the evaluations focused on participant satisfaction, qualitative personal assessments, as well as perceptions of the usefulness of the professional development activity (Gaytan & McEwen, 2010).

None of the literature enabled Gaytan and McEwen (2010) to study the actual impact to student learning as the product of training. One of the major detractors of each of the studies was the fact that most studies were conducted within hours of the conclusion of the training. Gaytan and McEwen recommended evaluating training as a follow up study a specified amount of days or weeks after the training was conducted. Time is needed to implement any changes that are necessary following a professional development event. Participants are often quick to use suggestions learned through professional development, but they tend to quickly digress to more comfortable strategies after an extended time passes between staff development activities that lack reinforcement for their efforts (Gaytan & McEwen, 2010).

While dissecting the studies methods involved the different perspectives from which the participant engaged in the activity, Gaytan and McEwen (2010) noted that some studies included various disciplines across many different educational settings. They also found participation in the professional development interventions described in

the studies was not required in some studies but was mandated for all instructional technology staff in others. Gaytan and McEwen developed a model for future study that involves using a plan, action, and evaluation flow chart. The focus on the evaluation of this research leads the reader to ask where an examination of the planning phase would be documented through this study. No reference was made to needs assessment data necessitating the need for training. The evaluation phase of the model focused on five outcomes by asking the following: (a) How did the training impact students? (b) Was there a change in instructional practices? (c) Was organizational support evident? (d) Did the participants internalize the training? (e) What was the satisfaction rate of the attendees? The first three questions seemed to be the focus of the research to provide evidence that these crucial components were missing in the majority of the evaluation models Gaytan and McEwen (2010) studied. Ironically the final two questions focused on teacher learning and satisfaction remained in the evaluative frame of the model suggested even after the harsh criticism of the past methods.

Critics of Technology in Schools

In the mid to late 1990s, critics of the impact of technology to affect the educational process were numerous. Oppenheimer (1997) reflected on earlier inventions that were touted as leading to full scale educational reform such as the motion picture leading to an end to textbooks. One of the most noteworthy studies of that era was the Apple Classrooms of Tomorrow (ACOT) project by Reeves (1998). Reeves concluded that the simple presence of technology in the classroom and at home has very little impact on the student achievement in the ACOT schools; however, when coupled with a

change in pedagogy, such as the implementation of project-based learning, collaboration or extended time on task, the findings were positive. The focus on technology rather than on pedagogy represents a major obstacle in whole school reform. The technology-enabled classroom bridges the gap to these advanced pedagogical practices. Efficiencies in research, communication, and innovation are all made possible by technology, but pedagogy must also change in order to advance the American public education system.

Summary

This chapter outlined several best practices for taking these first steps toward full integration of one-to-one technology device immersion. Three models emerged to guide schools through the transformation process and the components of each model were reviewed. The eight tenets that emerged as central to this movement were curriculum, instruction, and assessment, shared vision, campus leadership, technology, networks, and hardware, data and privacy, community partnerships, professional learning, and budgeted resources. All eight tenets are all central to a lasting and successful technology immersion reform effort.

CHAPTER THREE: METHODOLOGY

This chapter contains the descriptions of the methodology and procedural processes involved in conducting this qualitative case study. Information shared in this chapter consists of the purpose for the study, research questions, methodology rationale, and procedures. The various sources of data, sample description, procedures for data collection, methods for data analysis, and steps to ensure the integrity of the study are also included in this chapter.

Purpose of the Study

Research regarding mobile technology immersion in the K-12 public school setting is limited (Greaves et al., 2010; Gulek & Demirtas, 2005; Lemke & Martin, 2004c). The purpose of this study was to discover what policies, actions, and experiences contribute to the successful implementation of a one-to-one technology initiative in a K-12 public school district. The design was a case study of an urban public school district's high schools and was conducted from the lens of grounded theory research. Central to this study was the necessity to measure central office administrators', campus leaders', and teacher leaders' perceptions of how the instructional leadership culture of a school campus promotes or thwarts the successful integration of mobile technologies into teachers' instructional practices.

Several factors were examined including the complex interactions of vision, leadership, curriculum, pedagogy, professional development, technical support, funding, and communication. The Future Ready Framework designed by the Alliance for Excellent Education's Future Ready Schools (2015) as well as the Essential Conditions

designed by the International Society for Technology and Education (ISTE, 2016) guided and framed the tenets examined in the case study. The theoretical framework was presented in Chapter One.

A case study view into the successful implementation of one-to-one computing was accomplished by examining the implementation experiences of teachers, two high schools' leaders, and two district-level leaders. The case study district demonstrated success with student achievement in the past 5 years as well as demonstrated a favorable financial position with the district. Therefore, the case study of successful one-to-one technology integration provided ample data for the development of grounded theory.

Research Questions

This study was focused on the following research questions:

1. What factors contributed to the successful implementation of the school districts' one-to-one mobile learning initiative?
2. What challenges do the participants identify as present during the implementation of the school district's one-to-one mobile learning initiative?
3. What recommendations about the sustainability of successful one-to-one mobile learning initiatives do the participants have?

Research Method and Design

Qualitative research was chosen as the overarching methodology for this case study in large part due to the richness of the content and data generated. Public school systems are dynamic and diverse organizations that include an enormous amount of tradition, norming, history, and cultural relevance not only in the organization but also in

the community as a whole. A quantitative approach to an integration of one-to-one mobile technology could not convey the "story behind the story." Miles and Huberman (1994) suggested the depth of the layered storyline to be essential when depicting qualitative research as follows:

> With qualitative data, one can preserve chronological flow, see precisely which events led to which consequences, and derive fruitful explanation. Then, too, good qualitative data are more likely to lead to serendipitous findings and to new integrations; they help researchers to get beyond initial conceptions and to generate or revise conceptual frameworks. Finally, the findings from qualitative studies have a quality of "undeniability." Words, especially organized into incidents or stories, have a concrete, vivid, meaningful flavor that often proves far more convincing to a reader – another researcher, a policymaker, a practitioner – than pages of summarized numbers. (p. 1)

The qualitative research methodology was used in this case study as way to describe with richness the stories of the participants and the challenges, both personally for the participants and organizationally within the school district, that led to the success of full technology integration. The perceptions identified by teacher leaders, campus administrators, and executive-level administrators at the central office level necessitated using a method that allowed the researcher to gather data related to each individual's experience within the case study context (Willis, 2007). The participants had their own worldviews that influences their interactions during the integration as well as those whom they work and interact.

This study included a grounded theory approach and a case study design to identify a theory of specific events explaining the phenomenon within the bounded system, or case for study (Merriam, 2009). The specific event in relation to this study involved the integration of mobile, one-to-one technology made available to every student in Grades 9 through 12. The identified case was an urban school district with successful student achievement as evidenced through standardized tests results as well as perception surveys conducted by the district. The rationale for conducting a case study from a grounded theory approach appears below.

Grounded Theory Approach

The focus of a grounded theory approach to investigation is to create or generate a theory from the study. Creswell (2007) defined grounded theory as a "design in which the researcher produces a general explanation of a process, an action, or an interaction shaped by the views of a large number of participants" (p. 83). A grounded theory approach will be used to develop a practical and usable framework for urban schools to follow when implementing ubiquitous one-to-one technology in support of students in the urban public school setting. This process was used to add theoretical explanations of emerging technology integration data collected to develop a theory or framework for further research (Creswell, 2007).

Research exists in many grounded theory studies that suggests a blind qualitative process. Grounded theory calls for a delay in the literature review process until after the analysis has been concluded in order to avoid contamination of data (Thornberg, 2012). This approach is contrary to the design of this study due to the fact that the review of the

research necessitated the grounded theory approach by revealing a lack of research based on implementation strategies in the area of technology integration in one-to-one environments. The research serves as a building block of terms, inspiration, data, creative associations, and critical reflections viewed through multiple lenses.

Case Study Design

The case study design has been used multiple times across varying disciplines. The case study design is used to expand knowledge about individual, group, organizational, social, political, cultural, and related phenomena (Yin, 2009). The case study method allows researchers to incorporate the real-life scenarios and events that influence the culture, climate, processes and even outcomes of the implementation. Merriam (2009) and Creswell (2007) identified the case study design as a method of exploring an issue or phenomenon through a bounded system, or case. This study required a case study design due to the limited amount of public school districts that have a one-to-one mobile technology ratio. This created a specific phenomenon through a bounded system of a single school within a large school district.

Site and Participant Sampling

Site and participant sampling for this study was a twofold process. The case study site was selected first. The participants were chosen using the methods outlined below.

Case Study Site Selection

Due to the focused research on the phenomenon of the urban public school districts that have implemented a one-to-one mobile technology program as a larger

scope of whole-school reform, the availability of specific, bounded sites was limited. The financial resources of the school district were also a condition for the selection of the district requiring a continuation of the resources available to continue the phenomenon. Another criterion for selection was that the school district must have shown academic improvement during the implementation period, as evidenced by the State of Texas accountability measures. The school district was chosen by using these criteria-based, purposive methods to recruit a public school campus that met the aforementioned criteria. Only districts in Texas were considered for the study. After reviewing the pool of districts that met the specific criteria for the study, an urban district was recruited successfully for the case study.

Sampling and Participants

The site district employed all participants chosen for this study. A triangulation of participants included data from lead teachers and campus-level administrators of two high schools and executive-level administrators located at the central office administration building. Each participant had been continuously employed by the district during the initiation of the whole school technology reform effort. Twelve semi-structured interviews were conducted at the campus or in the office at which the participant was located. All interviews conceptually generated data related to the participant's tenure, background, and education. These interviews were also focused on the phenomenon of the one-to-one technology integration. Each interview was no more than 45 minutes to enable teachers to interview during their planning periods and to ensure administration leaders could participate in interviews, given their busy schedules.

Data Sources

There are numerous sources of evidence or data most commonly associated with a case study design, including but not limited to documentation, archival records, interviews, direct observations, participant observations, and physical artifacts (Yin, 2009). The primary sources of data for this grounded research study were the one-on-one interviews (Creswell, 2007). However, artifacts were evaluated as part of triangulation and for the development of a grounded theory.

Questions that were asked by the researcher focused on how the participants experience the process and identify the steps in the process (Creswell, 2007). Anecdotal steps in the process were described as well as how these steps unfolded in the larger goal of whole school reform. This researcher used a semi-structured interview process, which allowed the researcher to choose the questions in advance of the interview; however, participants had the freedom to respond to situational elements as they arose in the course of the interview. The researcher had the opportunity to ask follow-up questions and to seek clarifications to answers. The questions asked during the interviews appear in the following list under each applicable research question that guided the study:

1. What factors contributed to the successful implementation of the school districts' one-to-one mobile learning initiative?
    - 1.1. What was the vision of school improvement communicated at the onset of this initiative?
    - 1.2. What outcome or product was expected when implementation was complete?

1.3. What were the (explicitly) expressed goals?

1.4. How did campus leaders communicate and support the implementation?

1.5. What was the knowledge of the curriculum, instruction and technical aspects at the roll out that campus leaders had?

1.6. What did they communicate as the challenges associated with implementation?

1.7. Who championed the initiative more than anyone?

2. What challenges do the participants identify as present during the implementation of the school district's one-to-one mobile learning initiative?

2.1. What were some of the technical challenges?

2.2. What were some of the technical successes?

2.3. Was a product used to manage the devices?

2.3.1. If so, was it successful?

2.3.2. How so?

2.4. What was the infrastructure present like?

2.4.1. Would you call it robust?

2.5. How was information about the campus initiative shared with parents and community stakeholders?

2.6. What role did the District's curriculum and instruction department have in the initiative?

2.7. What training did you receive in curriculum and instruction during the implementation?

2.8. Was it successful?

2.9. What was the total costs of the training?

2.10. Did implementation provide means to pedagogy through different modalities and individual student needs?

3. What recommendations about the sustainability of successful one-to-one mobile learning initiatives do the participants have?

3.1. How are you currently using technology as an instructional tool?

3.2. Have you experienced a change in leadership during this implementation?

3.3. And if so, has the support, direction, or vision changed?

Data Collection Procedures

To ensure that appropriate steps were taken to protect the privacy, rights and welfare of the participants in the study the researcher obtained approval from the Institutional Review Board (IRB) at The University of Texas at Austin. The selected district was contacted and agreed to participate in this study. A verbal commitment was obtained from the district's superintendent and IRB.

Interviewing the teachers and campus administrators present during the one-to-one technology integration phase and two central office administrators allowed for triangulation between the semi-structured interviews' data (Patten, 2009). There were

three levels of integration experiences represented by the three levels of participants. Prior to the formal interview process, the researcher established a protocol by piloting the interview questions on a specific teacher in the district who would not be eligible to participate in the case study because of working at a different campus.

The participants identified for interviews were selected through purposive sampling, as explained previously. An assistant superintendent was contacted, and she agreed to an interview. An additional central administrator also agreed to participate in an interview. These two district leaders allowed the researcher to have access to the two high school sites for conducting interviews with campus-level administrators and teachers. The researcher contacted each high school's principal and scheduled the interviews. The study's inclusion of two high school campuses with one-to-one technology implementation enabled the researcher to obtain differentiated points of views and perspectives.

Each interview began with an explanation of the purpose of the study in order to keep all interviews aligned within the case study. Introductory open-ended general questions were asked to help establish rapport with the participants. These interviews were conducted face-to-face at the location of the phenomenon being researched and lasted no more than 45 minutes. All interviews were tape recorded and transcribed. The research site as well as the participants in this study were assigned codes to ensure that responses do not identify any participants. Data including transcripts and recordings were stored in a locked closet, and electronic data were maintained behind a password protected firewall.

Data Analysis

Three coding strategies were used in the data analysis process of the research that were central to applying the grounded theory model. First, open coding was conducted during the artifact data collection and interviews. This strategy enabled the formation of specific categories of information that relate directly to the phenomenon (Creswell, 2013). Using the initially broad categories, several properties of the perceptions were realized.

The second stage in the data analysis involved an axial coding process of the emergent categories that were based on open coding. As the categories led to patterns and themes that guided theory development, the conditions surrounding this phenomenon were further examined. Finally, the process of selective coding was used to draw conclusions uniformly within a narrative format. These processes occurred simultaneously and evolved from reflective journaling which contained theoretical memoing that enabled the researcher to capture the evolving theory throughout the coding process.

In order to keep a detailed and relevant account of the interview process, reflective journaling and theoretical memoing was used by the researcher to provide a level of richness in relation to the processes and implementation. The researcher kept a reflective journal to chronicle specific feelings, hunches, and speculations about the coding processes and identifications of the emerging theory (Creswell, 2013). This process also allowed the researcher to overcome any biases that were uncovered throughout the coding process.

Strategies to Promote Trustworthiness

The validity and trustworthiness of the research findings was assured through several strategies. Peer debriefing and review were central to this study, due to the researcher's biases relating to the models for implementation used in two other school districts. A type of researcher effect could have created bias toward certain groups of responses or strategies reported to be used during implementation. Three peer experts were used for debriefing purposes during the course of the design data analysis.

The interview questions, specifically, were peer reviewed to ensure question relevance or validity by an editor as well as a recently retired superintendent of a large one-to-one district outside of the state of Texas. Another educator evaluated the codes against the data to determine the accuracy of the analysis. The reflective memos and review protocols were also subject to peer review and debriefing for ensuring biases were overcome.

Summary

This chapter contained an overview of the research design as well as procedures for the data collection and analysis. The case study design was described as well as the methods of data analysis and trustworthiness. The procedures for conducting the case study of two high schools in a single one-to-one technology school district were depicted with detail. Chapter Four provides the setting specifics of the two high schools that participated in the case study and of the participants as well as the thematic findings of the study. Central themes are discussed in addition to the detailed, specific responses obtained in the interviews in Chapter Four.

CHAPTER FOUR: FINDINGS AND ANALYSIS

The purpose of this case study within an urban school district in Texas was to discover what policies, actions, and experiences contribute to the success of a one-to-one technology initiative. The researcher explored the leadership aspects of policy that contributed to the successful implementation of mobile technology. The researcher uncovered the challenges the participants reported as present during the implementation of the district's one-to-one mobile learning initiative. The researcher identified what perceptions the participants had regarding the sustainability of the successful one-to-one mobile learning initiative. Qualitative data were obtained through 12 interviews examining one-to-one initiative perceptions of three levels of leadership. Two interviews were conducted targeting central office leadership, four interviews were conducted at the campus leadership level, and six interviews from the teacher leadership perspective. The findings discussed in this chapter articulate the perceptions of the participants for answering the following three research questions.

1. What factors contributed to the successful implementation of the school districts' one-to-one mobile learning initiative?
2. What challenges do the participants identify as present during the implementation of the school district's one-to-one mobile learning initiative?
3. What recommendations about the sustainability of successful one-to-one mobile learning initiatives do the participants have?

Data Collection

This study's data collection began after receiving approval from the university's IRB and the district examined IRB process. The site of the case study was a large urban school district located in the State of Texas. The characteristics that the study required regarding a diverse socioeconomic, racial, cultural and ethnic were met by the district being studied. The two high schools recommended by the district's central office leadership met the study's student population requirement. The district's central office leaders recognized two high school sites as successful in the implementation of the one-to-one mobile deployment, instructional use, and sustainability. The differentiation of the high schools was only that High School A was a magnet school and High School B was a comprehensive, open enrollment school.

Before beginning the study's required face-to-face interviews, I counseled with the university's advising committee and contacted the superintendent of the identified district. The superintendent supported the study's focus referring me to the district's IRB process where approval was obtained. An assistant superintendent was contacted, and she agreed to an interview as well as an individual on her team. This department then suggested the two high school sites examined in the study. I contacted each site's principal and scheduled the interviews.

Face-to-face interviews with two central office administrators, two campus administrators at each site, and three teacher leaders at each site. A total of 12 interviews were conducted in order to research varying perspectives of the implementation, operational, and sustainable influences on a successful one-to-one mobile initiative.

Before beginning each interview, I informed the participant of the nature and focus of the study, the time allotted for the interview of 45 minutes, and the anonymous provisions of their shared information. Each participant signed an agreement to participate in the study. Interviews were conducted in various private rooms at the district's professional development center and the two high schools studied. Interviews were conducted during the day and during teachers' conference periods. All interviews were audio recorded and later transcribed. These transcripts allowed for determining the specific word counts for finding emerging trends, titles, and themes. All interviews were conducted over a period of 3 days.

Introduction of Participants

The participants in this case study were grouped into three categories of respondents. Two participants interviewed held supervisory positions at the District's central administration office and received the pseudonyms o Central Office 1 (CO1) and Central Office 2 (CO2), respectively. Both of CO1 and CO2 spent over five years working in the District and were knowledgeable about the mobile initiative. They also had worked with three different superintendents during that 5-year span.

Four campus administrators were interviewed. Of the four, only one served as the campus principal. This individual is Campus Administrator 1 (CA1) in the study. The campus principal had gained experience in the district as a previous high school principal and was moved to a supervisory role at the central office, before returning to the campus to champion the initiative.

Three campus administrators served in the support role of assistant principal. Of the three assistant principals interviewed, Campus Administrator 2 (CA2) was extremely knowledgeable about the strategies related to implementation and relayed information directly tied to research. Campus Administrator 3 (CA3) had only been employed at that campus for 2 years but was brought to campus due to experience gained in a similar initiative in the district at the middle school level. CA3 was able to provide comparisons and contrasts between the two implementation efforts. Finally, Campus Administrator 4 (CA4), as an experienced administrator, had been on the campus throughout the beginning of the one-to-one technology implementation. CA4 was knowledgeable about pedagogy, PLC processes, and student discipline issues in terms of their relationships to one-to-one technology immersion.

The faculty participants varied greatly in years of experience. The first three teachers interviewed worked at High School A. The initial interview conducted with Teacher 1 (T1) involved this teacher as an individual knowledgeable about the specific technological aspects of the one-to-one implementation by virtue of having the role of teaching computer technology to students prior to the one-to-one mobilization. T1 had, in essence, been involved in a one-to-one initiative by nature of her position.

Teacher 2 (T2) was a veteran instructor with over 25 years of experience. T2 was knowledgeable about the process of school reform and repeatedly mentioned "new programs" when referring to whole school reform. All of T2's experiences occurred at this campus.

Teacher 3 (T3) teacher shared a positive experience with the implementation. T3 had over 15 years of experience. T3 was extremely complimentary of the High School A's administration.

The teacher participants at High School B represented the same department. Teacher 4 (T4) had 20 years of experience and had an assignment teaching advanced placement classes. T4 shared positive perspectives of student and campus leadership involvement. Teacher 5 (T5) was knowledgeable about technology and referenced using specific software for inclusion in the pedagogy. T5's experience in the classroom spanned 9 years.

Teacher 6 (T6), the final teacher interviewed at High School B, was an experienced teacher with 21 years of service to the district. T6 provided a significant contribution to understanding the challenges relating to behavioral discipline and the technology policy related issues of the reform effort. Table 1 provides a summary of the participants' locations between the district and two high schools.

Table 1

Participants' District and School Assignments in the Case Study

Central Office	High School A	High School B
CO1	T1	T4
CO2	T2	T5
	T3	T6
	CA2	CA1
	CA3	CA4

Data Codes

As mentioned in Chapter Three, three coding strategies were used to find thematic conclusions relating to the three groups of participants, and their perceptions of the implementation process. The coding strategies of open, axial, and selective coding allowed the data to be compiled in a thematic format to validate the redundant nature of the responses. The initial open coding process followed a line-by-line inquiry allowed the researcher to approach the subject without any preconceived thoughts or biased predictions. Specific wording of the respondent's answers revealed several titles and qualitative themes to emerge from the interviews.

The next coding process necessitated the initiation of axial coding. This allowed the researcher to further refine the responses identifying links to the original titles and themes, and find patterns of responses that further define the perceptions of the participants. The data were clustered and further defined producing clarity of titles and themes.

During the third and final process of the coding phase, the researcher examined the earlier refined themes by enabling a process known as selective coding. This phase allowed a deep analysis of the responses by interpreting the nodes and codes, clustering the responses, and removing outliers to make a meaningful set of findings. The data patterns that emerged during this phase allowed for generating coherent findings and feedback that led to the narrative.

The findings were clustered by respondents to examine the perspectives of the three groups of participants for varying outcomes relating to the implementation of the initiative. Table 2 displays the word frequencies and key words that emerged as the most frequent identified by central office respondents. Table 3 contains the most frequently used words by campus level leadership. Finally, Table 4 depicts the most common terms used by teacher leaders through the interview process.

Table 2

Most Frequently Used Words by Central Office Respondents

Word	*n*
School	78
Student	68
Teacher	66
Device	58
Technology	57
Campus	42
Learn	41

Table 3

Most Frequently Used Words by Campus Level Leadership

Word	*n*
Student/Kid	158
Technology	125
Teacher	114
Need	79
Use	79
Now	74

Table 4

Most Frequently Used Words by Teacher Leaders

Word	*n*
Use	144
Student/Kid	95
Teacher	89
Laptop	80
Want	73
Now	73

Emergent Themes

The findings examined here came from the various themes emerging from the data. The answer to the first research question included the communication of a vision for the mobile one-to-one initiative, the expected outcomes and goals of the initiative, and the evaluation of the initiative in relation to student learning. The next research question's answer related to the implementation for curriculum and instruction and technicalities as well as the challenges associated with implementation. The third research question included data about what aspects of the one-to-one initiative were believed by the participants to enable the initiative to be successful.

Data compiled from the interviews related to the research questions were organized into five comprehensive themes. First, *teacher and leadership "buy-in" or support* pertains to the specific need for all leadership and staff to support the initiative. *Communication of the initiative* relates to the success of the initiative and focuses on the

participation of the students as well as the parents in the expectations of the initiative. The third theme emerged during the interview process as the need for *reliable and consistent hardware and software*. Participants often focused on the type of technology hardware chosen as well as the reliability and usability of the devices. *Outcomes, goals, and evaluation* were consistently discussed regarding perception surveys and usage monitoring. Finally, *professional development* emerged as thematically relevant to the one-to-one technology initiative. Identified within this topic was the importance of the Tech Integration Leadership position as it was viewed by central office, campus leadership and teaching staff. Multiple respondents communicated the need for continuously employing an individual focused on pedagogy, technology support, and relationships as part of the sustainability of the initiative. Each theme is presented through the lenses of all interviewed participants. Summarizations and direct quotes appear in the presentations of five themes.

Teacher and Leadership "Buy-In" or Support

A consistent theme that emerged throughout the interviews was the need for school-wide support of the initiative. Both of the central office administrators, three campus administrators, and four teachers referenced the success of the initiative as due in large part to "buy-in" from teachers and leaders from the campuses' administration. One central office administrator believed that the difference in the success or failure of the initiative was due to the belief and vision of the principal. CO1 stated:

> The campuses that had strong leadership touting the one-to-one initiative had the best outcomes. We determined that it was the strongest campus principals that

have the best programs. The ones that were saying "We've got to either too much other stuff going on," "That's on my back burner," or "I don't have time for that right now" never got it done.

Campus administrators communicated similar reasons for success, but identified teachers and students as believing in the initiative. Meeting a need, which will be examined further, propelled the campuses to find success. Campus administrator CA2 expressed this belief as follows:

> Our campus had a great deal of success with the one-to-one roll out. The students bought into it quite a bit because it met a need. The teachers bought into it. We did a lot of professional development and we did a lot of discussion. I think it's just the storytelling aspect of it.

Four of the six (66%) teachers mentioned the importance of the getting the staff "on-board" with the initiative. The largest hurdle to keeping the teachers on board with the change often came from the difficulty of maintaining the devices. Managing the new environment seemed almost overwhelming to some, and a need for a more focused, pragmatic approach was mentioned by the teaching staff. Even when touting the success of the initiative on the belief of the concept by the teaching staff, some frustrations were still evident. T1 expressed noticing a relationship between teacher "buy-in" and device management. When asked what was the overall factor that made the initiative successful, she stated the following:

> Teacher "buy in," because if you don't have teacher "buy-in," then this isn't ever to work, and we didn't have it at first because they kept changing things on us.

> Like when we rolled out … our first learning management system and it was touted to be so wonderful, and then at the end of the year, "oh, it's going away." So, [the next LMS] came in. Well, nobody was willing to get on board because it was "just going to change the next year. What's the point of learning something, and understand that's a waste of time." And I think that we've had buy in at our campus, but I don't think that they're fully implemented the way it could have been, had clear direction been given.

Communication of the Initiative

The two central office administrators communicated the need for the vision and leadership to be communicated and directly supported by the superintendent. Both participants identified the importance of the vision of the superintendent at the beginning, and the continued need for continuity throughout the implementation. One respondent, CO1 replied as follows:

> Number one in my mind is having it be led by the superintendent. If the initiative is led by the technology department, it's not as important as if there's a model implemented at the top. At the very beginning of the initiative, when we started ours, we had a superintendent that was all about the one-to-one initiative. He left, and we had an interim for about a year after that, and it all of a sudden became my initiative. And then, that was a little more difficult.

CO2 saw the implementation as being successful when the campus principal was supportive and championed the initiative. CO2 believed that the successfulness of the

initiative was due in part to the willingness of the campus principal to institute the initiative as follows:

> I think principal buy in was a big part when we first rolled out [one-to-one technology] in the fall of 2014. We started with six pilot schools, and I went around and met with each of our high school principals, and the ones that I met with, I could kind of figure out if they had buy-in and if the program was going to start off as a success. Were they going to allow time for professional learning? So, principal buy in and professional learning, I think, are key.

When addressing the need for the initiative to speak to a broader, comprehensive school improvement initiative, both respondents believed that the central, driving factor for school improvement was to prepare students for college and career readiness. About partnering with a local university, CO2 specifically responded:

> We visited a professor and sat in on his class. He used a lot of technology. He was recommended to us. And so, we had a conversation with him about the types of technology he uses, what his students know when they come into his classes. Does he have to stop and take time to teach them about a learning management system? Like he uses the learning management system, Google classroom, not only Google classroom, but Google for education. He used a lot of those pieces, and we just felt like he said that most of his students came in with the device, either an iPad or a laptop.

CO1 expanded the need for the initiative to change the learning environment by increasing student engagement and mentioned the need for the initiative not to be simply about the device.

Communication of the initiative was further examined from the campus level and respondents were asked how campus leaders communicated and supported the implementation. Campus leadership perspectives on communication was focused more narrowly on the campus faculty, students, and parents as stakeholders in their communities. Closely related to the focus from the top campus administrators was the importance of the principal being engaged and supportive of the initiative. Many comments related to a change in how they were conducting school operations, instruction and efficiency. CA2 said, "The principal, the administration, we made a big deal out of the one-to-one rollout. It wasn't just a thing we were doing. It was a change in how we were doing things."

The campus leaders mentioned on several occasions the importance of getting the device into each student's hands. At the campus leadership perspective, successful implementation was viewed as total implementation. They said the need for the technology helped move the initiative forward and focused on the success of the initial deployment. CA1 clarified this concept with the following:

> There wasn't a clear vision except a need. I think the vision that was expressed is this is what needs to happen. Part of why we were successful is because we pushed crazy hard to get almost a hundred percent of the students with the device.

Communication with parents during the deployment was part of the successful implementation. Numerous reflections were provided that expressed the importance of involved parents. Most neighborhoods affected by the initiative were impoverished; however, all campus leaders expressed the need to charge a fee for the device to ensure student and family "buy-in" happened. Two administrators mentioned that, in many instances, this technology represented the first computer every introduced to the home. CA3 said, "What I mean by that is the school has a vision for how to distribute the technology to students. They have partnerships with parents, and so we educate parents at the beginning of them receiving" the technology.

The six teachers' representations about the communication of the initiative varied greatly. One teacher did specifically identify a survey used for evaluating the outcomes. Five of the six teachers explicated that usage of the devices offered a means to manage classrooms. T5 explained this classroom management in the following:

> I felt like I was told you have to use [the LMS]. These kids are getting their laptops; make them use of them. And I hadn't been here long enough to say anything otherwise, so I just did it. My understanding of the outcome or product that was expected was student and teacher usage at a high level.

An incentive was offered to encourage the teachers to use the technology as mentioned by T4:

> We were doing like a monthly, "tech teacher of the week," whatever for the teacher who was using the technology most frequently, or in the most unique

ways. So, we had an incentive program. Recognition was emphasized, and I think that lasted for about three months.

Outcomes, Goals, and Evaluations

When asked specifically about the outcomes, goals, and products expected by the initiative, the two respondents at central office responded initially about the seamless use of technology in the classroom under more global terms; however, when pressed for more tangible examples, CO1 responded about the physical outcomes of the hardware issued to the students:

> We measured the rate of lost and stolen devices as a way to keep track of usage of the campus. But it was kind of a back end way to do that because if we had hardware lost or stolen, obviously they weren't being used. That was one of the biggest takeaways that we were able to go to the campuses and say the campuses that utilized the technology daily didn't have the number of breakages, the number of lost and stolen. And we determined that it was because it's being used every day. The ones that were thrown in the back of the car, thrown under the bed: They got stepped on, and nobody even knew it. They weren't being used in the classroom, so the teacher wasn't able to stay on top of it. So, it's almost opposite of what you would expect. You would think those that are being used more would have more damage, but it's the opposite. Those that are being used in the classroom everyday had less lost and stolen.

CO2 did provide a specific data point used for measurement of use by the district. Its implementation became more evident as teachers spoke to the one-to-one evaluation

surveys that the district administered to determine that usage of the issued devices. CO2 spoke to the program:

> We assessed our teachers and students with [the one-to-one evaluation surveys] and so it kind of told us what we needed to do, where we were lacking, what we needed to focus on for professional learning moving forward. So that kind of, guides our work a lot. That's a lot better than most when you're actually look at that data.

Outcomes, goals, and evaluations of the initiative were prompted from the campus administrators' level. Three responses were compiled at this level from student achievement to teacher usage. One campus administrator focused on the percentage of students issued the device, another mentioned the SAMR model; however, no campus administrator provided a direct correlation to the implementation of the model. Finally, CA2 responded that "teacher usage" was the benchmark gauged as follows:

> Because my teachers are not experts with technology. Part of the test goal has been the implementation of technology within their classrooms. So, we tied it to our test goal. Levels of engagement with tech because of the teacher's expertise levels. I would say that what I'm expecting is for teachers to engage in technology within their classrooms to deepen student knowledge.

Teachers responded in different ways to the expectations of goals and outcomes and goals of the initiative. Two teachers believed that the goal of the "one-to-one" was for teachers to use the technology with one teacher mentioning student achievement. One

teacher mentioned college and career readiness, while another teacher saw it as preparing students for technology.

Professional Development

From the central office perspective, professional development was key to implementation. The district provided funds from resources and expertise found within the district's staff. Each campus was assigned a Technology Learning Coach (TLC) to assist teachers with lesson planning and delivery. Common sense curriculum was mentioned as a way of providing the necessary tools to help students navigate the digital integration. Almost all participants referred to the curriculum and instruction department as lacking involvement. Thematically across all participants at both campuses and central office referenced the importance of the TLC position to the teachers. CO1 tied the importance of professional development together by the following statement:

> Some teachers, rather than having to come after hours for training or do stuff during a Saturday, he let him do it during the school day, which was fantastic. Teachers shouldn't be expected to come after school or on their own time. Then, we had another campus with a strong leader, and my coach being one of the strong leaders, we said we want all of the campuses to get common sense media certified digital citizenship.

At the campus administrative level, three out of four (75%) respondents referenced the importance of the training that was provided to the teachers about the district's learner management system (LMS). One campus administrator went so far as to

imbed the LMS software into his campus faculty meetings. CA3 highlighted the importance of the LMS with this statement:

> The learning platform was crucial to the integration process. And so, at the onset, I actually looked at this platform. Okay. So, I love it. All right. So, at this point, I informed our faculty that all of our stuff for our next faculty meeting is in there. The whole agenda was in there. All the pieces that were in there. I didn't kill 10,000 trees giving them stuff. All right. And so, at this point, I just started, and I said, "Click here, I need for you to go with this." And our Technology Learning Coach was teaching them as I was going through it, and they were like, "This is so cool." And I said, "We'd better get accustomed to it." I said, "And for the next 3 weeks, [specific name] is going to be here in the morning, lunchtime and afternoon. I expect all to be good to go through an hour training on [the LMS]. We're going to prepare you."

Campus administrators always came back to the success of the roll out, and in some cases, mentioned other campus initiatives that were not successful. Campus administrators were directly involved in the process and took pride in its success. CA1 mentioned the capacity and capabilities of the TLC at onset stating the following:

> Luck would have it. He was very, very good, excellent. And so, at that point I sat down with him and I said, "We have or I have figured out a three part communications plan." I said, "I want this to be right, and I want us not to have the same issues that everybody else is having: because nobody, nobody did a roll

out that should have been successful. They just got them and then started trying to issue [them to students].

Three teachers stressed the importance of the TLC. Both campus administrators and teaching staff mentioned that the initiative had suffered some setbacks without the campus presence of the TLC. During the first year of implementation both high schools had a full-time TLC on campus. Presently, four teachers identified that the coaching numbers have been reduced, and they are no longer staffed with on TLC on each campus. Two teachers noted that this change in TLC staffing represented a disconnection for the teaching staff from needed technology support and professional development. School librarians are receiving retraining to become digital media specialists as an attempt by the district to fill that void. Five of the six teachers mentioned how competent their original TLCs were. T4 made the following statement:

> Most of the technology side of things was taken care of by our TLC. If we noticed or found out about something that was being misused on a particular computer, then the apps would just kind of show the way. We to go back to him; he was a huge part of the success. You could go to him with any question like with what I want to do. I went to him with what I wanted to create for my class project. I wanted them to have to do these video lab reports and be able to collaborate and I had no idea how to do it. He showed me, and I think he did that for a lot of people.

Need for Reliable and Consistent Hardware and Software

Thematically, across all participants, information was provided about the reliability of the measurement tools in use. Data communicated from perception surveys pointed to issues related to reliability of the devices, because 84% of the teachers surveyed had informed the administration that the lack of policy initiatives to address student usage was an issue at onset. Refresh cycles were mentioned by half of all groups with a large amount of uncertainty surrounding around the migration from Windows devices to Chromebooks. The shift in hardware was largely perceived as a way to save financial resources by four of the teachers (66%). Both central office administrators referred lacking in the needed resources to keep the devices working and struggling with accountability for students not bringing their devices to class. CO1 expressly mentioned the issue by stating:

> There were no extra techs hired for my tech team, and the customer service team also reports up to me. They felt like this support wasn't there for student devices, they were there to keep the district's equipment, as far as teachers and staff, ready. They weren't there for the students. They don't deal with the students.

The campus administrations' perceptions about the reliability of hardware and software involved the many technical issues needing to be solved by the TLC. Placed initially on each campus to support the instructional delivery of the initiative, these coaches found their time being spent troubleshooting device and software issues. If the devices were not working, then the planning and efficiency of the implementation could never be achieved. While campus administrators did not directly monitor technology

work orders, or "tickets" as they were often referred to, their responses represented the policy issues affecting the reliability of the software and hardware. CA1 characterized the issues below:

> The logistics of storing, handling, signing up all of those laptops, monitoring appropriate use was our largest issues. As soon as things get broken, the device management of damaged laptops, determining who causes the damage, what happens when devices are lost. I mean, that's the world I still live in. Is this a police report, or who's going to pay for the damage when we collect the devices? What happens when they come back in there junky? Another issue was the people would get invested in a program, and then the program would be discontinued or would stop being supported.

Two of the three teachers representing each of the campuses (i.e., four out of six interviewed teachers across both campuses equally) reported having technical issues relating to fully charged devices. Three teachers reported teachers had different expectations for technology use by students in classrooms. T4 said, "Students may have an expectation for use in one classroom but not the same expectation in another" classroom run by a different teacher.

This independence of classroom culture by teachers often resulted in students not bringing their devices to classes, and when they did bring their devices to class, the devices were not ready to be used because their batteriers were not charged. T1 explained this phenomenon, and the issues relating to this frustration:

> Students often did not bring their device to class, or the batteries not charged. I ended up giving that as a grade. If you came to the school with your computer charged, that was participation grade for the day. That was the only way I could get them to charge it. I also have computers in our room, so if I plug it in certain places, it causes the fuse blow. So, I bought those towers, those little electric towers, because the first year I was going to be hard-nosed, you were going to bring it charged. By golly, I wasn't going to help you. Alright, well, I finally gave up, and I bought the towers and now they can only charge them at the front of the room.

Summary

In Chapter Four, the success of the one-to-one technology initiative was presented as based on the qualitative interviews with three types of participants in order to represent triangulated data points. Central office administrators, campus administrators, and teachers provided their perspectives and experiences with one-to-one technology in this case study. In the narratives depicted five themes within the study's data from two central office administrators, four campuses administrators with two each at two high schools, and six teachers with three each at two high schools. The realistic, rich depictions of each participant's experiences added to the breadth and depth of the study. From the five themes that evolved through the coding of the data, the three over-arching research questions were answered. Chapter Five contains the discussion of this findings and concludes the presentation of the case study.

CHAPTER FIVE: DISCUSSION

As stated in Chapter One, access to mobile personal technologies by students has been accelerating since the beginning of the 21st century, and educational leaders have been continuously called to lead this transformation. When assessing the public school environment, technological innovations have transformed the operational landscape. Financial software has streamlined budgeting and purchasing, transportation operations today can give exact GPS locations of busses and help managers create efficient routes, and school facilities are planned with computer assisted blueprints. However; the classroom environment, has seen little innovation as it relates to teaching and learning. An enormous investment has been made on digital tools and resources to attempt bridge this divide (Moersch, 2014). Over $5 billion are spent annually by schools to incorporate technology, and technology has been integrated in public schools in a variety of ways (Moersch, 2014). Therefore, a case study of the policies, actions, and experiences that contributed to the successful implementation of a one-to-one technology initiative offered an opportunity to inform school district leaders about using this technology model. This chapter contains findings of the study summarized according to the central three research questions and the subtopics that emerged. Discussion of findings, implications for further study, and research recommendations are offered as part of concluding the study presentation.

Summary of the Study

To fulfill the purpose and answer the research questions, a grounded theory approach and case study design offered an effective exploration of the specific events

within the bounded system or case of technology integration (Merriam, 2009). The primary data collection method was interviews with 12 educators in the urban school district that had implemented its one-to-one technology program and completed the fourth year of the program. Two high schools were represented by three teachers and two administrators working in each high school. Ten participants represented the two high schools. The other two participants were the executive administrators at the urban district's central office. The 12 participants provided data relevant to their experiences within their social contexts (Willis, 2007).

The two central office administrators' responses were compared and contrasted with the perceptions provided by the 10 participants representing the two high school campuses' faculty and administrators. All participants related their perceptions and reflected on the challenges associated with the initiative to provide information that could benefit future implementations. Finally, the participants did provide recommendations about the sustainability of the program. The data codes reflected the complex interactions of vision, leadership, curriculum, pedagogy, professional development, technical support, funding, and communication that affected the successful implementation of the one-to-one technology initiative in the urban school district.

Summary of Findings

The three research questions investigated in this study were designed for probing the processes that enable the successful implementation of one-to-one mobile technology initiatives. As mentioned earlier in Chapter Four, five emergent themes were identified as answering the three research questions. The five themes are the following:

1. *Teacher and leadership "buy-in" or support* as the specific need listed by all 12 participants.
2. *Communication of the initiative* which was identified by participants as important to parents, students, and educators and to the success found throughout the deployment of the devices, the care and handling of the devices, and the interaction that teachers encountered with the new devices in terms of lesson planning and assessment.
3. *Need for reliable and consistent hardware and software* which was focused on the type of technology hardware chosen, the reliability and usability of the devices, and ways to reduce viruses and lost or stolen laptops.
4. *Outcomes, goals, and evaluation* as evidence of success that included tracking the usage of the devices by teachers and students with growth in both categories from Year 1 to Year 4.
5. *Professional development* as related to the campus TLC's efforts formed a crucial aspect of the success of the initiative in addition to other methods of professional development mentioned by participants as positive that included multiple days of off-site training as well as specific training on the district's LMS.

A summary of each research question's findings appear in the next few subsections.

Research Question 1 Summary

This question asked: What factors contributed to the successful implementation of the school districts' one-to-one mobile learning initiative? The central theme emerged to

answer this question as teacher and leadership "buy-in" or support was necessary to implement the initiative with fidelity. The two central office administrators focused on the importance of leadership to initiate the implementation. Both participants stressed the importance of the role of the superintendent and how the success of the initiative changed during a transition between superintendents. The superintendent that began the one-to-one initiative communicated the need for change prior to the mobilization; however, after the change superintendent leadership occurred a change in focus was found. The communication of the need for the initiative became inconsistent following the district's leadership transition.

Of note, both central office participants resolved that a principal's leadership and "buy-in" at the campus level was instrumental in the success of the initiative. The campuses with principals who embraced the change, saw the need for the change, and supported the initiative were the most successful with the initiative. The competencies of these principals, in terms of communication, strategic design, professional learning, and device "roll-out," were evident to the central office participants. They also believed that these leadership qualities enabled the principals to focus and share a belief in the need for the one-to-one. Central office administrators also relayed information that teachers have been using formative assessments more often because of the one-to-one technology access increasing the viability of this process for promoting learning benchmarks.

The campus administrators spoke about having a similar "buy-in" necessity for the success of the initiative but identified teachers as central to the initiative's success. By supporting the changes in pedagogy, communication, and systemic structures of their

classrooms, teachers made the initiative successful. The campus administrators spoke about teachers witnessing the fulfillment of students' learning need through the one-to-one mobile initiative and communicating their experiences to campus leaders. The campus administrators identified teacher-leader "buy-in" and teacher competence and/or experience as necessary to embracing the program. They noted these factors enabled other teachers to get "on board" with the systemic change.

The teachers focused on whole-class implementation, and multiple responses spoke to the importance of all students having access to their devices during the class period. The structures for dissemination were communicated and implemented. The participants said it was important for students to have a sense of ownership by paying a nominal fee for their assigned devices. Teachers regarded staff development and the administrators' expectations for use of the one-to-one technology as positive. Several comments identified the quality of professional development they received during the initial phase of the program as critical to the initiative's success, but they found they experienced challenges due to the absence of the professional learning focus when the TLC positions were removed from their campuses. This issue also related to the findings of the second research question.

Research Question 2 Summary

This question asked: What challenges do the participants identify as present during the implementation of the school district's one-to-one mobile learning initiative? This investigation revealed one of the most comprehensive themes that emerged through the entirety of the study involving the need for reliable and consistent hardware and

software. The participants discussed needing device management and technical help. They reflected on expectations for students to use their devices. Substantial feedback was identified concerning the ability for all students to participate in lessons in large part because of behavioral or technical support for the students' laptops. Issues concerning the implementation challenges include communication, pedagogy, and lack of involvement by the district's curriculum and instruction departments.

The central administrators identified specific issues related to the lack of accountability for implementation with the professional teaching staff. Campus leaders assumed, in some instances, that teachers would set expectations for implementation with their students and set goals for themselves relating to implementation. A key success factor for the implementation of the initiative revolved around low device losses were related to high classroom usage. In one instance, the central administrator identified a less than 1% loss rate of devices. This data point highlighted the use of the devices by the students and the need by students to keep the devices working for finishing assignments and completing project-related activities.

Campus administrators lamented the challenge of the sustainability that involved the TLC position loss on the high school campuses. The participants believed the initial implementation was more successful in the first years than in the current environment due to the on-campus support provided by TLCs. Although the district continued the TLC positions in the district, the number of TLCs was reduced, and the physical location of the coaches was centralized and removed from the campuses which seemed to provide a barrier to teachers' technology learning. All four campus administrators spoke to the

competencies of their campuses' TLCs, and the relationships that these individuals had fostered with the teaching staff. The campus administrators included the TLCs as supporting teachers through difficulties related to student behavior and interacting with the devices.

Interestingly, the two high schools' campus administrators had different perspectives about the current usage of one-to-one mobile technology in the classrooms. One campus administrator confidently expressed that between 90% and 95% of the school's faculty incorporated the devices into every day's lessons. At this campus, the campus administration mentioned the progression of full implementation by using the SAMR model to gauge teacher use and competency. However, the other campus administrators believed the devices were in use in only about 30% of the classrooms on a daily basis and that most teachers would probably still be defined in the initial phase of substitution.

Additional challenges included ensuring the devices were charged for each class as well as for the entirety of the school day. Off-task behavior as well as inappropriate uses were mentioned as detrimental to the learning environment by participants. When the students were not engaged in the lesson, they used the devices for gaming or personal projects rather than for focusing on the goals of the subject or lesson. Administrators' time was consumed by interacting with students and teachers to correct these behaviors that hindered the success of the implementation.

Teachers initially mentioned having a level of anxiety about this initiative being "one more thing to do." A failed first LMS led to increased apprehensiveness among

staff and students. One surprising finding involved students as not equipped to use technology even though teachers had long perceived students as "ahead in technology" due to the ubiquitous nature of technology in their environment. Teachers discussed the challenge of teaching students how to use the basic functional technology resources of email, writing software, and presentation software. Students lacked basic typing skills, as well as formal communication competencies due students' proficiencies with the casual communication prevalent in social media. The participants regarded students' informal, slang, or colloquial communication skills as a barrier to the formal, professional communication skills and the rigorous requirements of the mandated curriculum students must learn in class.

Communication of the initiative was routinely identified as a barrier or challenge that occurred both during the implementation and continuing through the present sustainability phase. The most obvious example of the communication challenge was identified by the participants as relating to their lack of knowledge regarding the funding source that provided the budget to initiate and sustain the one-to-one learning program. The central office administrators relayed information that initial funding was realized through the process of a tax ratification election (TRE). The TRE allowed voters in the district to support the initiative by agreeing to raise the local tax rate through a referendum election. This TRE provided program sustainability due to the fact that the revenue was ongoing and would represent an annual injection for the district's budget.

The campus administrators mentioned that on several occasions, their belief that the revenue to fund the initiative was realized through bond funds included in a recent

capital improvement project, while teachers alluded to believing that grant funds and local revenue sources were the means used for purchasing the one-to-one initiative's laptops. Some teachers admitted to being unsure how the district acquired the funds to purchase the devices. Also, the teaching staff did not know the process and decisions that led to the decision of which hardware to purchase. A change in hardware is currently being implemented, and this subject is discussed in response to the third research question.

Finally, the main disconnection occurred in the perceptions that the one-to-one initiative support was provided by the district's curriculum and instruction department. The district's curriculum and instruction department had several initiatives planned simultaneously as the one-to-one initiative. These simultaneous projects often left participants feeling overwhelmed. When asked specifically about the pedagogical changes or shifts necessitated by the use of the new technology, participants could not present any affirmative responses relating to the curriculum and instruction department. They did see the campus-level TLC as providing support, and the TLC's services at both high schools' campuses appeared to be extremely beneficial to the participants.

Teachers received incentives for attending training sessions, such as teachers accessing $100 worth of resources for their instructional planning and delivery. Teachers communicated that the focus of training was almost always about the tools being used rather than use of specific content and best practices with those tools. Teachres did not connect with use of the LMS for curriculum pacing or documents related to the district's scope and sequence. Teachers did not have opportunities to combine the resources for

fluidity of lesson planning and assessment. When asked about the curriculum pacing documents, participants said those documents had been completed 10 years ago, remained in that software and format, and were not upgraded for current technologies.

Teachers expressed a perception that when the district moves to the Chromebook platform, students will not be able to work on assignments without Internet access outside of the walls of the school. The science teachers communicated concerns about the Windows-based experimentation software lacking compatibility with the new devices. Teachers responded that technology usage levels on campuses were much lower than campus administrators believed them to be.

A relationship challenge was discussed as detrimental to the implementation by the participants. Some teachers and campus administrators responded that removing the TLC positions from full-time campus status to work from within the curriculum and instruction department hurt the sustainability of the initiative. Participants viewed this structural move as detrimental to the relationships and face-to-face training opportunities that initially made the initiative successful. The technology department and the curriculum and instruction department seemed to most participants as separate entities with very little communication or coordination of vision. The participants did not know what department to call regarding their one-to-one needs without having the TLC on campus. This challenge represents the need for discussing the recommendations found in the summary of the third research question findings.

Research Question 3 Summary

This question asked: What recommendations about the sustainability of successful one-to-one mobile learning initiatives do the participants have? Participants recommended the inclusion of technology in their current planning and instructional practices; better communication of the funding of the initiative; and ideas for "refresh," or the replacement cycles of the devices. As expected, the knowledge relating to the initiative's programmatic cycle planning diminished at each level of participant. The recommendation findings enable a clearer understanding of the emergent framework regarding the use and need of the mobile technology in public schools.

The two central office administrators understood the effects of the TRE and the purpose for those funding sources to carry the initiative forward into subsequent years. Both central office participants communicated having a clear understanding of the timelines related to the replacement cycles and the devices that would be used in the future. The central office administrators also spoke to understanding of issues relating to the management of the devices and recommended steps for addressing the behavioral and technical issues identified by the teaching staff. First, several online courses have been developed for the district since the initial one-to-one technology deployment for enabling staff and students to use the technology with effectiveness. Second, district-wide face-to-face training was initiated to help teachers streamline classroom management by using this technology immersively. Third, adjustments to the program have been made based on data collected in the one-to-one evaluation surveys.

Arguably, the most important recommendation for the initiative was to provide a clearer vision of the "4 Cs" of education. Central office participants identified the "4 Cs" that formed the vision of the sustainable one-to-one initiative as critical thinking, communication, collaboration, and creativity. These four tenets were identified as necessary for helping teachers and students use one-to-one technology as a tool to communicate appropriately and professionally, question sources of information, broaden collaboration by tearing down the walls of local PLCs for pedagogical awareness and resources, and use a plethora of media sources for the creation of content-related products.

Teachers recommended increased communication at all levels about refresh cycles so that they could have better buy in for changes in technology equipment and platforms. Teachers reported, for example, that the moving away from the Windows platform to Chromebooks offered the district an opportunity to save money rather than to focus on sound instructional delivery through technology. They would have liked to have been consulted about the technology resources they use in science education.

Numerous recommendations about maintaining sustainability in the ever-changing world were made by participants. The participants discussed how ongoing technology development affects college readiness needs and workforce automation. Teachers perceived that the administration's measurement surveys of the initiative were evaluated by the administration. However, many teachers believed that measurable expectations about one-to-one technology use should have been placed on them to ensure success of the initiative in the long term. In sum, a research-based theory begins to

emerge in the third research question's findings. Aspects of a model include the earlier identified strategies of PLCs, the SAMR model, and the "4 Cs" of education, which are also considered to be bedrocks of institutional reform.

Discussion of Findings

The case study involving two public high school campuses housing Grades 9 through 12 in an urban school district provided successful examples of one-to-one mobile integration. Research from Chapter Two is incorporated as material to inform on several norms identified in the study findings and offer context to the findings. The phenomenon of one-to-one technology in the classroom, which involves assigning a computer to each and every student, was studied. As this instructional arrangement becomes more prevalent, research of such implementation has become necessary to understand how to effectively institute the technology model throughout public education.

ISTE (2011, 2016) provided a framework for technology integration in public school environments that was presented in Chapter One. The findings of this study are compared to the tenets of this framework for purpose of discussion. The ISTE framework begins with examining the concept of visionary leadership that is defined by actions that inspire and lead to the development and implementation of a collaborative vision for technology integration (ISTE, 2015). In this case study, numerous participants offered varying examples of the importance of leadership during the implementation of the initiative. Visionary leadership from the superintendent enabled the initiative from inception. Leadership change served as a catalyst affecting the success or failure of certain aspects of the initiative.

Closely tied to visionary leadership is the communication of the initiative as a shared vision. Clarity of purpose helped connect the organization to the cultural change necessary for successful systemic improvement. The defining characteristics of the mobile computing initiative were shared in the data by all participants; however, they had many different answers regarding the need for the initiative. Identifying and understanding the need for change leads to an environment that promotes systematic change within the organization (ISTE, 2015).

The theme from this case study of teacher and leadership "buy-in" or support has been demonstrated in past research on many topics, but also it represents a prominent tenet defined within the ISTE (2016) standards. The 12 participants revealed that the success of the initiative was directly tied to their belief that the initiative was important for their students' academic successes and college and career-readiness development. The participants held the belief that the change was necessary, which led to the one-to-one technology initiative as a successful whole school reform grounded in cultural change. The mobile one-to-one initiative data from the two urban high schools depicted the administrators and teachers as dedicated to the effort of systemic whole-school reform. Their buy-in led to school cultures that supported professional learning and in which technology was as important as the learning of the individual students. The changes in the cultural processes of the high schools' organizations enabled systemic collaboration and other school-wide reforms that included professional communication through PLCs. Once these communication avenues are opened by way of a mutual

whole-school goal, other areas and relationships built for cross-curriculum planning add to the whole-school environment's success and enhances student achievement.

Discussing the need by participants for reliable and consistent hardware and software, Roscorla (2012) noted that uses first focus on the device, issues concerning the type of device, and bandwidth availability and reliability. Teachers interviewed in this study relayed similar information but spoke to the success of the policies, changes in bandwidth, and development of better models of classroom management that increased the amount of technology usage and decreased the amount of off-task endeavors as the initiative matured in Years 3 and 4.

For the theme regarding outcomes, goals, and evaluation, the district measured teachers' perceptions and found them to be consistent. Data reflected an increase in student and teacher usage of the devices by comparison from Year 1 to Year 4 of the initiative. The district followed researched models of SAMR (described in Chapter Two) and the "4 Cs." For SAMR, a mobile technology immersion model first introduced by Ruben Puentedura (2012), the district identified benchmarks related to teacher and student interactions with their assigned devices. Participants needed structure and expectations for the initiative. Most participants spoke to using the devices as first order substitution and as primary productivity tools at the onset of the initiative. Campus administrators referred to the goals of the initiative as not simply having the devices become another "source of pen and paper."

Measuring the progress of the initiative allowed the district to focus the organization on systemic success. Substitution, while the first step in the process, was

communicated as the most prevalent, very important step in the initiative's success. The use the device represents the only way that professional staff become comfortable with the technology and with changing their expectations for students and their outcomes. Once use was immersive, modification and redefinition of classroom practices and student use expectations followed in accordance with the SAMR model. A rubric allowing staff to move through the SAMR model with examples of benchmark achievements to enhance this initiative was not found in the data, however.

Professional development is the most compelling thematic finding of this research. While all three groups of participants agreed on the importance of this activity towards a successful integration model, the varying degrees of success for the district's professional development efforts was glaring. Most studies of professional development outcomes are conducted within hours of the conclusion of the training (Gaytan & McEwen, 2010). Because time is needed to implement any necessary changes following a professional development activity, ongoing accessible professional development providers, such as TLCs, may offer the best practice approach. Technology or instructional coaches who participated in teaching the educators to develop meaningful, relevant, and rigorous lessons represented a critical aspect of the initiative's success in the data from both administrators and teachers. Relationships built by the TLCs as "master-teachers" enabled teachers to be vulnerable to peer assistance rather than seek out help from their evaluators. These "champions of the process" as evidenced by investigation can be leveraged to promote whole school cultural reform. Moving away from the school-imbedded TLC model after the one-to-one initiation stage led to the

teachers finding the technology burdensome because of lack of access to support, and the administrators echoed the concern. The need to maintain an imbedded TLC for professional development and sustaining the one-to-one culture of the school as a means for maximizing the effects of a successful initiative is among the implications described in the next section.

Implications for Practice

The case study investigated through this research identified practical perceptions of K-12 public school practitioners who participated in a school-wide reform effort in which all students were issued school funded mobile technology devices. The efforts of this investigation identified several implications for practitioners seeking to enact best practice one-to-one strategies during future technology initiatives and whole-school reform efforts. The implications for practice are derived from the five overriding themes of the research that were based on the perceptions of the individuals who participated in the one-to-one initiative.

First and foremost, the research reflected the need for focused and systematic communication of the vision. When participants were asked about the goal of the initiative, they did not share a common answer. Leadership was central to the participants in the success of the initiative; however, the participants did not communicate a clear, shared, or central goal. Central office participants reflected on the importance of the visionary support of the superintendent at the initiation of the reform but also responded that once that leader left the district, the clarity of vision shared by that leader lost sustainability. Messaging the need for change is an important first step in

any whole school reform effort, and sustainable efforts to develop and accurately communicate the vision across leadership changes are needed for initiatives designed to outlast any one superintendent's tenure.

For the theme of outcomes, goals, and evaluation, the district did perform evaluation surveys. The data attained by the district measured device usage, not student achievement due to device use. The district focused on data regarding teacher and student use and perceptions of the devices. The participants could only reflect sparingly on the impact of student achievement due to the one-to-one initiative. Only one participant related information about efforts to increase in student achievement with the one-to-one technology during the 4-year period. Gaytan and McEwen (2010) concurred the actual impact on student learning as a product of training needs attention. Therefore, student achievement goals must be central to any effort for whole-school reform.

Finally, the research findings revealed the need for ongoing, imbedded staff development. Participants reflected positively on several district efforts relating to teacher learning. In particularly, the campus administrators and teachers identified their successes as due to the TLC's involvement and assistance and the relationships built by the TLCs with their school's staff. The TLCs' competencies, communication, and availability initiated a successful start to the initiative, as reflected by all participants. However, the participants uniformly realized a disconnect with the one-to-one implementation when the district discontinued the imbedded TLC program. Clearly, staff development that is relevant and available on a daily basis was central to the success of the efforts of the reform. Superintendents and school boards would be well served to

invest in the continued practice of school-imbedded technology coaching as part of their regularly budget planning in order to sustainably promote and ensure teacher learning that benefits curriculum delivery.

Recommendations for Further Research

The themes lead to the need for further research regarding the whole school reform efforts initiated by the one-to-one mobile initiative. The methods used in this study might be strengthened by employing differing methodologies and larger sample sizes in future research for addressing the phenomenon of the one-to-one mobile technology initiative. Quantitative and qualitative investigation methods could be used in follow-up research of the central themes identified in this case study's findings. Specific studies for future researcher are presented in the following:

1. Multiple participants spoke including all stakeholders in the implementation process for ensuring the success of the initiative. By converting the qualitative findings into a survey, data could reveal a correlation between support levels of staff, students, and parents in relation to the success of a one-to-one initiative. Stakeholder survey data could be used alongside the application of strategic planning models for gaining broader understand of the sustainability of this phenomenon.
2. Communication and vision were discussed in depth during this case study. Participants indicated experiencing ambiguity in the messages they received about the initiative and how it was funded. Future case studies of successful initiatives that incorporate a strong, well communicated vision, need, and

marketing plan would be beneficial to public school superintendents and school boards seeking models to emulate.

3. Today's use of social media has changed the traditional communication model. Teachers need a set of best practices for communicating through social media in terms of boundaries, frequency, medium, and audience.
4. Prior research speaks to device selection decisions as important to the implementation of a one-to-one initiative (Roscorla, 2012). Evidence in this study reflected similar need for understanding by the six teachers about how selections were made. Information about the decision making process could be attained through district surveys to learn the most prevalent device, hardware reliability and dependability, and role of pricing.
5. A study focused on programmatic implementation leading to student achievement is needed. Only one participant mentioned the increase in standardized test scores relative to the initiative, and most participants were unclear as to how the one-to-one reform was evaluated. Because very few quantitative studies have studied relationships between student environments immersed in technology and test scores (Siemens, 2005), this type of causal-comparative design would be timely for today's era of public education accountability. Large data sets could be used to correlate one-to-one technology characteristics with student success whether measured by test scores, graduation rates, or college and career readiness.

6. The findings suggest the need for effective professional development of participants. While perception surveys, including this case study, have determined professional development has value, very few studies ascertained any parallelism between professional learning and student achievement (Gaytan & McEwen, 2010). Grouping professional development activities for successful one-to-one initiatives with student achievement outcomes would be another means to identify their benefits of one-to-one mobile initiatives.

Conclusion

The purpose of this case study was to discover what policies, actions, and experiences contribute to the successful implementation of a one-to-one student technology initiative in a K-12 public school district. The participants represented three professional employee categories of central administration, campus administration, and teaching staff. The large urban school district's majority of students were identified as economically disadvantaged. Twelve participants shared their experiences and perceptions of the implementation of the district's one-to-one mobile technology strategy in two high schools. In each high school, all students and faculty were issued a district-owned laptop device. The data revealed five emergent themes that explained aspects of the whole-school reform within the district that follow: (a) teacher and leadership "buy-in" or support; (b) communication of the initiative; (c) need for reliable and consistent hardware and software; (d) outcomes, goals, and evaluations; (e) professional development.

Based on this researcher's past personal experiences in two similarly designed one-to-one implementations and on the evidence attained through the literature reviewed, the participants responses were consistent with current practices in the field. Systemic structures, policies, and practices that were identified in this case study could be replicated and improved upon to maximize future practice. Participants identified several factors that are prevalent in the research, and in many cases consistent with models of implementation identified in Chapter Two.

While many of the one-to-one initiative elements identified appeared to be included without completeness, the participants identified needs for these processes and structures. All participants relayed having a need for stakeholder "buy-in" or support and intensive, real-time, and accessible professional development. The participants stressed the importance of the reliability of the devices and recommended following inclusive processes for device selection and support. Communication of a school reform vision that benefited student achievement was found integral to the implementation process. Finally, one-to-one technology initiative evaluation requires collecting data for making evidence-based decisions that will ensure the program's sustainability. In closing, the successful implementation of the one-to-one initiative at two secondary sites within a large urban school district led to several best practices that could be emulated in other districts.

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